DUAL USE OF DEFENSE TECHNOLOGY

NG

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

OF THE

COMMITTEE ON MERCHANT MARINE AND FISHERIES HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

DUAL USE OF TECHNOLOGY AND RESOURCES FOR CIVILIAN AND DEFENSE OCEANOGRAPHY

AUGUST 4, 1993

Serial No. 103–60

Printed for the use of the Committee on Merchant Marine and Fisheries

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DUAL USE OF DEFENSE TECHNOLOGY

WEDNESDAY, AUGUST 4, 1993

House of Representatives, Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf, Committee on Merchant Marine and Fisheries,

Washington, DC.

The Subcommittee met, pursuant to call, at 2:10 p.m., in room 1334, Longworth House Office Building, Hon. Solomon P. Ortiz [chairman of the Subcommittee] presiding.

Present: Representatives Ortiz, Green, Weldon, Hochbrueckner, Furse and Torkildsen.

Staff present: Sheila McCready, Staff Director; Tom Kitsos, Senior Policy Analyst; Sue Waldron, Press Secretary; Lisa Pittman, Minority Counsel; Robert Wharton, Greg Gould, Terry Schaff, and Chris Mann, Professional Staff; Dave Whaley and Margherita Woods, Minority Professional Staff; and John Aguirre, Clerk.

Mr. Ortiz. The Subcommittee will come to order.

OPENING STATEMENT OF HON. SOLOMON P. ORTIZ, A U.S. REPRESENTATIVE FROM TEXAS AND CHAIRMAN, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

Mr. Ortiz. Good afternoon. I would like to welcome all of you here today on behalf of the Subcommittee on Oceanography, Gulf of Mexico and the Outer Continental Shelf. Today the Subcommittee meets to discuss the dual use of technology, resources and data to advance ocean research and management. Over the past few decades, the defense community has built a strong capability to study and monitor the oceans in support of defense missions. I have been a strong supporter of building and maintaining this capability and I believe that the strength of our military's research and development efforts have made us a world leader.

Through years of investment we have developed many valuable assets to observe, understand, and predict the ocean environment. There has been a lot of discussion recently on the need to continue operation of some of these defense systems and capabilities in today's world. I believe that many of these should be maintained. To do so, it may be necessary to explore alternative uses, both commercially and by the scientific community. In many ways, the civilian and defense oceanographic communities have worked toward similar missions. In others, the defense community has developed capabilities which may inadvertently provide valuable environmental information which was viewed as irrelevant.

A closer working relationship between the civilian and defense oceanographic communities can benefit both groups, allow us to use our resources more efficiently, and provide added justification for keeping important defense systems online. Although this is an important step, I believe that we must use caution and be sure that nothing will be done which would compromise national security.

We have already started to move in this direction. I hope that today we will hear some success stories and some historical perspectives on the interactions between defense and civilian scientists. Beyond that, I hope to gain a more detailed understanding of the mechanisms which exist to facilitate these interactions and to discuss some of the platforms, data streams, and other resources which have a high potential for dual use.

I welcome you all and I look forward to hearing your testimony.

The Ranking Minority Member, Mr. Weldon, should be here in a few minutes. At this time I would like to see if my good friend from New York, Mr. Hochbrueckner, has any statement to make.

STATEMENT OF HON. GEORGE J. HOCHBRUECKNER, A U.S. REPRESENTATIVE FROM NEW YORK

Mr. Hochbrueckner. Thank you, Mr. Chairman. Like the Chairman, and also along with Congressman Weldon, the three of us do serve, as do many other members of the Merchant Marine and Fisheries Committee, do serve on House Armed Services.

Clearly, as I think most people know, we have made a tremendous effort on the defense side to utilize defense money to help us promote dual-use programs that, in fact, utilize defense money to help us produce commercial spin-off products to make us more competitive in the world marketplace.

Certainly, this year this $471 million of defense money that will be used to promote dual-use projects through ARPA and in the fiscal year 1994 budget there will be probably about $500 million.

Certainly, it is very proper and appropriate for this Committee to go in the other direction. Even though this year on Merchant Marine and Fisheries we are utilizing defense money to help rebuild our merchant marine shipbuilding capability.

So, it is certainly proper and appropriate for us at this point on Merchant Marine and Fisheries to talk about how we can utilize what we are doing on this Committee in order to also produce dual-use systems that can ultimately result in better commercial products to help us be more competitive in the world.

So, I think, Mr. Chairman I think this is a very proper Subcommittee meeting. And I look forward to the testimony specifically from the merchant marine area.

Mr. Ortiz. Thank you. The gentlewoman from the State of Oregon.

STATEMENT OF HON. ELIZABETH FURSE, A U.S. REPRESENTATIVE FROM OREGON

Ms. Furse. Thank you, Mr. Chairman. Thank you for letting me sit in on this wonderful hearing. As you know, I, along with Chairman Studds, have introduced a bill on environmental technology. I see that as very much part of the dual use. As we develop our envi-

ronmental technology laws around the world, the United States needs to be very much a part of promoting that around the world.

I am very interested to see how you will use this conversion feelings around this and the expertise around the issue of oceanography.

Thank you for scheduling this hearing. It is a very, very important issue and one that I think we are in a marvelous place to be working on right now. Thank you, Mr. Chairman.

Mr. Ortiz. I would like to include the statements of the distinguished gentlemen from Texas, Mr. Jack Fields, and also by the Ranking Member of this Subcommittee, Mr. Curt Weldon. If anybody else would like to include their statement, it will be included for the record.

Statement of Hon. Jack Fields, a U.S. Representative from Texas, and Ranking Minority Member, Committee on Merchant Marine and Fisheries

Mr. Chairman, you and the ranking Republican member of the Subcommittee should be commended for scheduling this hearing on an issue which is very new to the Subcommittee, but meshes well with positions you and Mr. Weldon have taken on the Armed Services Committee.

With improved global relationships melting the distrust of the Cold War, great opportunities exist for civilians to take advantage of the millions of U.S. dollars invested in military resources and use them for peaceful purposes. Oceanography is a field ripe for this type of cooperation.

Cooperation between the Navy and the National Oceanic and Atmospheric Administration (NOAA) is not new. In fact, in 1837 the Navy published the first nautical chart, a program now under NOAA's auspices. The Navy has detailed an Admiral to NOAA to act as liaison between the agencies. In addition, NOAA has memoranda of agreement with the Navy involving the use of a Navy submersible in the National Undersea Research Program, and Naval personnel are found at the heart of NOAA's fleet modernization effort.

This is a good start, but certainly there is more which can be done. NOAA's current nautical charting operations are disappointing. The availability of ship time for scientific research work is inadequate and growing more limited as the NOAA fleet faces obsolescence. Environmental data critical to the understanding of global climate change and ocean resource management is weak, and the resources are dwindling. I believe that many of the tools and technologies developed by the Department of Defense can now have a new life aiding these valuable programs.

In conclusion, I also want to commend you, Chairman Ortiz, and you, Mr. Weldon, for your efforts to include NOAA in defense conversion efforts as part of the Department of Defense Authorization bill. NOAA has valuable scientific expertise which can help target areas where defense technologies can be put to further use in environmental research.

Thank you, Mr. Chairman.

Statement of Hon. Curt Weldon, a U.S. Representative from Pennsylvania

Mr. Chairman, I want to thank you for holding these timely hearings. We both serve on the Armed Services Committee, and know very well the devastating effects that the military drawdown is having on the services, civilian employees and communities nationwide.

In my view, current conversion efforts have many limitations, but they also offer some great opportunities. The military has been the undisputed leader in U.S. technology development, and it has an array of equipment which could be used in the civilian community. We should ensure that assets no longer required by the military are made available to other agencies and that we maximize use of old and new military technologies.

The Chairman and I supported a provision in the Defense bill to include NOAA in the composition of the Strategic Environmental Research and Development Program (SERDP) council. This provision will help foster greater dialogue between DOD and NOAA, and increase environmental uses for defense technologies. I also have worked to ensure information sharing on environmental technology development among all Federal agencies, and put forward language to ensure that all agencies have access to the environmental requirements data base designed to solve high

priority environmental problems associated with base closure and that we begin to develop an interagency environmental clearinghouse.

These are only first steps. Today we want to hear other suggestions from our witnesses on how we can increase information and asset sharing between DOD and civilian agencies. I look forward to hearing their testimony, and once again, Mr. Chairman, want to commend you for taking this positive step to initiate the process.

Mr. ORTIZ. I would like to introduce the panel which consists of representatives of the civilian and defense agencies and academia. I know that some of you might have to go right after you testify. Feel free. I know you have some very important meetings to make.

First is Dr. James Baker, the new Under Secretary of Commerce for Oceans and Atmospheric. Let me take this opportunity to congratulate you, sir. He is the Administrator of the National Oceanic and Atmospheric Administration.

Dr. Baker, I know that we will be able to work together with you. There are a lot of things we would like to see done. I can assure you that this Subcommittee and members of this panel will work with you.

Mr. BAKER. Thank you, Mr. Chairman.

Mr. ORTIZ. Dr. Robert Oswald is Executive Director of the Strategic Environmental Research and Development Program. Next is Mr. Robert Winokur, Technical Director of the Office of the Oceanographer of the Navy. Welcome, sir. Dr. Eric Hartwig is Director of Oceanography at the Naval Research Laboratory. Welcome, sir.

Dr. Kenneth Daugherty is Deputy Director of the Defense Mapping Agency and he is accompanied by Ms. Laura Snow, Chief of the Program and Budget Office.

Last but not least, of course, is Dr. William Schmitz who is a Clark Professor and Senior Scientist at Woods Hole Oceanographic Institution.

Welcome to the hearing today. I think that we can begin with Dr. Baker.

STATEMENT OF DR. D. JAMES BAKER, ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION ACCOMPANIED BY DR. NED OSTENSO, ASSISTANT ADMINISTRATOR FOR OCEANIC AND ATMOSPHERIC RESEARCH

Dr. BAKER. Thank you very much, Chairman Ortiz. You and your Committee have identified a topic which we believe is central to the themes of the Clinton administration. Defense conversion, trying to do more with less, multiple uses of single instruments and in general trying to reach a viable and sustainable economy together with environmental protection is our goal.

Maybe I could just have a few personal words before I begin the official testimony. Before I became a government official, I was asked by Senator Gore to work with a few of my colleagues, including some on this panel, to help look at the defense assets, particularly classified assets, to see how these could be used for producing environmental data.

That led to the creation of the Environmental Task Force which has been very successful in its operations. We will be hearing some more about that activity. I should say also that Secretary of Commerce Ron Brown strongly supports the dual use concept.

We appreciate the opportunity to testify on dual use. We think that this concept offers potential for fundamental advances for ocean research and operations in general and for NOAA specifically.

These eyes and ears that are developed and operated at considerable expense to help defend our Nation can give us an unprecedented view of the ocean environment, including our management of living resources, prediction of natural disasters, knowledge of climate change and information on a whole host of other critical issues.

We see here a high payoff for a low investment. We believe that much still must be done to prove this potential. Some significant steps have been taken and many scientists feel the promise is good. We need now to identify the systems and technologies that are most likely to have useful environmental applications, to test and prove the most promising concepts, resolve the security and classification concerns about civilian use, and establish mechanisms and resources for dual use operation.

We believe that close cooperation among the Department of Defense, other Federal agencies, the civilian academic community and private industry can make this work.

Various interagency panels and working groups are now engaged in this first step. NOAA has participated in preliminary projects and anticipates more in the future. The process is working and we think that with encouragement it will succeed.

Let me speak first about the Integrated Undersea Surveillance System. We have several new applications that involve this new system. It is designed to locate and track ships and submarines acoustically. For several years now, NOAA scientists at our Pacific Marine Environmental laboratory (PMEL) have been working with the Navy to use the system as a research tool in their Vents Program. Their emphasis has been to detect, locate, and describe hydrothermal activity throughout the North Pacific Basin. Additionally, NOAA scientists at the National Marine Mammal Laboratory have identified and located endangered whales in the North Pacific using IUSS information.

The work has proven very successful, both as good science and as a demonstration of NOAA/Navy cooperation. In fact, this collaboration has been a stimulant for NOAA to seek other uses of this underwater system.

This project has evolved over several years to where it now uses a realtime data link from the Navy system to NOAA's facility in Newport, Oregon. There, the incoming acoustic data are processed to detect signals from volcanic and seismic activity. In a dramatic success, just recently this link detected and located a below the surface volcanic eruption just as it started a few weeks ago. A research ship in the area was alerted and sent to the location. It was able to collect rare water samples at the event. This type of quick response to a rare event, and the monitoring of more frequent hydrothermal venting events would only be practical with dual use of the IUSS.

Other significant IUSS applications have been proposed as well. These include:

Assessing global warming by measuring bulk ocean temperature using the technique of measuring the time of acoustic transmission;

Monitoring marine mammal behavior, migrations, and assessing population sizes and distributions—this is important as we look at enforcing the Endangered Species Act;

Monitoring and detecting driftnet and other fishing activity in the North Pacific and elsewhere;

Assessing fisheries stocks in exclusive economic zones;

Transmitting data from and locating drifting mid-water instrument packages; and

Measuring open ocean rainfall rates by listening to the sound as the water drops hit the water surface.

Demonstration projects for the first three—global warming, marine mammal studies, and driftnet fishing—have been or soon will be carried out. Several were funded through the Strategic Environmental Research and Development Program.

Bob Oswald is here to talk about that program. Although NOAA is not directly involved in some of these, their results may point the way for other long-term applications. The remaining three proposals have not been tested, but appear technically feasible and worth further study. The IUSS system clearly offers the potential for a range of civil applications, and NOAA strongly supports its dual use.

Let me speak next about ships. NOAA and the Navy are cooperating in identifying ships that can be utilized for civilian missions. NOAA has received three former T–AGOS surveillance vessels for conversion to meet specialized NOAA oceanographic and nautical charting mission requirements. NOAA will continue to investigate the feasibility of using surplus naval vessels to fulfill specific NOAA mission needs.

Another system for possible dual-use is the Over the Horizon (OTH) Radar, built for the Air Force. This system uses low-frequency radar to provide early warning of aircraft attack. Its potential application to ocean environmental studies arises because the returning radar signal which is reflected from the ocean surface is modulated by ocean wave conditions. Although this "sea clutter" is normally rejected when tracking aircraft, the information can be recovered by special processing.

Scientists from NOAA's Environmental Technology Laboratory have demonstrated the ability to extract surface wave and wind direction data over large ocean areas. They believe it will be possible to extract wind speed and wave height as well, parameters important to commercial shipping.

Applications of such data include observations to improve significantly synoptic scale modelling and weather forecasts in data sparse ocean areas. And a dramatic test during Hurricane Andrew last year demonstrated the ability to track these storms continuously in conjunction with satellite data as they approach the coast.

We are involved in an interagency task group exploring uses of the OTH radar. Because the Air Force already has decided to mothball the system, significant funding would be needed for continuing operations. Multiple agency participation for a variety of missions appears the only feasible option. We do not know what

the outcome will be of the interagency task group, but remain hopeful that a cost-effective mix of missions may be found.

The defense and intelligence agencies also operate other highly classified assets. Although we cannot provide further information about classified assets in this forum, NOAA is participating with others in the Environmental Task Force process to identify potential applications for beneficial civilian purposes.

As an example of processes to implement dual use, there was legislation in 1992 directing use of intelligence assets to support enforcement of driftnet fishing regulations (the High Seas Driftnet Fisheries Enforcement Act, Public Law 102–582). In this case, NOAA and the intelligence agency involved are in the process of establishing a separate Memorandum of Understanding. The application has proven very successful, and provides a capability we simply could not afford to match with more traditional ship and aircraft patrols.

The Department of Defense also cooperates with NOAA in providing access to, and use of, the Defense Meteorological Satellite Program (DMSP) data. For example, the Special Sensor Microwave/Imager data is used by NOAA researchers to study the soil wetness, precipitation, and similar subject's index. NOAA recently provided this data to the Vice President for his Midwest "Flood" briefing. NOAA participates in the shared processing data network for the exchange of meteorological satellite data and products. Also, NOAA provides the archive service for selected Defense Meteorological Satellite Program data sets.

NOAA strongly supports the concept of dual use for environmental purposes. A period of testing is needed to prove the value of each application, but the process should go forward.

Dual use implies civil access to environmental data. We believe that NOAA can contribute significantly to the conversion for civilian use of defense and intelligence assets and their historic data.

On the whole, except for ships and some other specialized facilities, NOAA believes that these assets should be operated in their parent agencies, preserving the integrity of the assets for defense applications. Dual use, however, would also allow the assets to be used to preserve our Nation's environmental and economic security. This is an important goal and one in which our defense-related assets can offer valuable contributions.

Thank you, Mr. Chairman. This concludes my testimony. I would be pleased to respond to any questions from you or other members of the Subcommittee.

[The prepared statement of Dr. Baker can be found at the end of the hearing.]

Mr. Ortiz. Thank you very much.

Mr. Ortiz. Dr. Oswald.

STATEMENT OF DR. ROBERT OSWALD, EXECUTIVE DIRECTOR, STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM

Dr. Oswald. Good afternoon, Mr. Chairman. I am Bob Oswald, Director of R&D for the Corps of Engineers. I am also the Execu-

tive Director of the Strategic Environmental Research and Development Program.

I am pleased to be here today to present testimony on the use of dual use defense technology for oceanographic research.

I would like to start out by stating that I am not an oceanographer, but I would like to speak to you today primarily in my capacity as the Executive Director of the Strategic Environmental R&D Program, also known as SERDP. SERDP is a congressionally-directed program which focuses Department of Defense research assets toward solving environmental issues.

The primary purpose of SERDP is to address the environmental matters of concern to the DOD and DOE through basic and applied research to meet the defense environmental obligations. However, one of SERDP's additional purposes is to apply DOD technology to nonmilitary environmental issues.

SERDP is also mandated to identify and transfer research technology information and data developed by both DOE and DOD to Federal agencies, State governments and private organizations. It is through this Congressional direction that SERDP provides the vehicle for transfer of dual use technologies with particular emphasis on environmental issues.

Defense technology will greatly enhance this country's ability to collect data and improve our understanding of the oceans, as Dr. Baker has just alluded to.

The environmental ocean science is a discipline that tends to be data starved. A variety of classified sensors and data sets developed by the DOD and the intelligence community offer the prospect of greatly expanding the boundaries of ocean science.

I would like to present some examples of the SERDP efforts that are building on national defense technology as described by Dr. Baker and to be further enhanced by both Dr. Winokur and Dr. Hartwig.

For example, the Navy has the extensive acoustic surveillance system, the IUSS, which has historically been used, as Dr. Baker described, for detection of vessels and submarines in ocean activities.

During the past year, starting in November of 1992, the Navy initiated a test of the sound surveillance system, the SOSUS, to try to track whales. I think this is an example of what can be revealed. The results of that six months of tests were remarkable, in fact outstanding, totally changing our perspective of the transport, migration depth, population, and activities of endangered whale species in the Atlantic, really revolutionary in terms of our understanding.

There are numerous other applications. Dr. Baker talked about a few in terms of monitoring ships and as a key to monitoring illegal driftnet fishing. The key that I talked about for understanding whales in the ocean, the same eyes and ears can be used to provide a greater understanding of the seismic activity that takes place there.

Previously we had very few, a very limited capability in terms of land-based seismic detectors to really monitor what was going on, on the ocean floor.

As Dr. Baker illustrated, that has changed with this application of the SOSUS system. Certainly, the oceans play a major role in climate change and Navy technology can benefit science here also. At present, our understanding of the ocean storage and air-sea exchange of both energy and gases is very primitive. But it is really key to understanding the global impact of environmental change and how the ocean interacts with the atmosphere.

Our SERDP projects will again pick this up as the bridge between the demonstration. SERDP will now pick up those programs and the vehicle by which we will fund those programs for the future for this dual use application.

In conjunction with the Navy and other research institutions, the Army is also conducting research on the physical, eletromagnetic and optical properties of sea ice. This is being done at our Cold Regions Laboratory and it is focusing on remote sensing signatures from satellite observation and how these signatures evolve with time as the ice thickness grows and decays.

The goal of these studies is to make better use of satellite and airborne remote sensing technology to determine ice conditions. The emphasis is to distinguish on ice types, surface conditions and possibly ice thickness. This program is basically going to use also the historical data that has been collected by the Navy submarine force and to use those profiles, along with this, will establish the baseline by which we can evaluate climate change as well as change in the ice cap and we will be able to use this because we will have a data base which extends over the past 35 years.

Many of these DOD systems show promise of improving our knowledge and understanding of the oceans and we are actively investigating the viability of these dual use applications. However, these systems and data bases were developed and fielded to fulfill specific military needs and missions and they continue to do so. Both the intelligence community and DOD are currently investigating the issues associated with a broader release of environmentally relevant classified data. These reviews cover classified data collected or provided by satellites, aircraft, and land sea-based systems. Recommendations for release or downgrading of classified material will consider benefits to the scientific and government policy communities as well as ensuring that we do not risk national security.

At least some of the deliberations of the various reviewing organizations are expected to be completed in the fall of this year.

In addition, there are issues concerning the cost associated with making these data routinely available to the scientific community. Again, these issues are currently being studied and have to be resolved before we move to full implementation.

I would like to close by saying these are just some of the DOD capabilities which can improve our understanding of oceans and global change. These technologies represent a new set of eyes and ears that the nonmilitary scientific community did not have before. The application of this DOD research and technology will rapidly expand the availability of ocean-related scientific information.

As directed by Congress the SERDP program in partnership with the DOD and intelligence communities is playing a key role in

making this technology available to the scientific community. I am available for any questions, Mr. Chairman.

[The prepared statement of Dr. Oswald can be found at the end of the hearing.]

Mr. Ortiz. Thank you. We have a series of votes on the House Floor at this moment. We will recess for 10 minutes and we will come back and continue with Mr. Winokur's testimony.

The Subcommittee will recess for 10 minutes.

[Recess.]

Mr. Ortiz. We will go ahead and continue with our testimony. There is a possibility that we might have a series of votes within the next 30 to 40 minutes. Maybe we can take the testimony and get into the questions.

STATEMENT OF ROBERT WINOKUR, TECHNICAL DIRECTOR, OFFICE OF THE OCEANOGRAPHER OF THE NAVY

Mr. Winokur. Thank you. Mr. Chairman and Members of the Committee, I am Robert Winokur, Technical Director, Office of the Oceanographer of the Navy. I am pleased to be here this afternoon representing the operational programs and capabilities of the U.S. Navy. I welcome the opportunity to comment on the dual use of Defense, and in particular Navy technology, for civilian oceanographic research.

The Navy has long recognized that our infrastructure and capabilities are not just Navy assets, but are of significant value to national activities in oceanography. Civil benefits from Naval Oceanography include charting, navigation, typhoon warnings, oceanographic data bases, ice forecasting, precise time, technology development, deep sea research, underwater acoustics, satellite remote sensing, and underwater vehicles.

Mr. Chairman, I would like to take this opportunity to outline specific examples of the dual use of Navy operational oceanographic technologies and data, as well as fleet operational systems and capabilities. In the interest of time, I will focus on a few specific examples.

The Navy GEOSAT satellite was launched in March 1985 with a primary mission, to measure the earth's shape, or geoid, with a high degree of accuracy. These data were initially classified. Subsequently, the Navy declassified all of the Geodetic Mission data acquired by GEOSAT south of 30 degrees of South for release through NOAA. In addition, GEOSAT's wind and wave data were released from the classified mission for distribution by NOAA.

A GEOSAT FOLLOW-ON (GFO) is planned for mid fiscal year 1996. Building on the success of GEOSAT, the GEOSAT FOLLOW-ON will be in the same 17-day exact repeat orbit as GEOSAT. The altimeter data will be processed by Navy and all environmental data records disseminated to NOAA's National Environmental Data and Information Service for distribution to the civilian community.

The first Defense Meteorological Satellite Program Special Sensor Microwave Imager sensor was launched in June 1987. The instrument measures cloud water content; rain rates; water vapor over the ocean; marine wind speed; and various sea ice, snow, and

land surface characteristics. A total of seven SSM/I's are scheduled to be launched through the next decade. SSM/I data and derived products are unclassified and made available to the civilian community in near realtime through NOAA. In fact, NOAA recently utilized SSM/I data to vividly demonstrate the extent of flooding in the Midwest.

The Navy has made available its Deep Submergence Vehicles Turtle and Seacliff and its nuclear submarine NR–1 for civilian oceanographic and deep sea research. Approximately 60 days of civilian use is available each year, and perhaps as many as 120 days per year could be provided if additional funds for civilian use were made available to the civilian research community.

The U.S. Navy takes approximately 150 expendable bathythermograph or temperature observations per day for operational use. In addition to supporting naval operations, these observations are important for a number of civilian applications, including ocean and global climate change modelling. The U.S. Navy declassifies most of these data after 30 days, thereby contributing approximately 55,000 observations per year to the public domain data base. These data are sent to NOAA's National Oceanographic Data Center for archives and unrestricted distribution.

The Navy's Integrated Undersea Surveillance System is a highly capable military system that provides an unmatched acoustic observatory into the ocean for both Navy and civilian applications. IUSS has the potential to contribute to nationally important scientific and civil applications, as well as to develop advanced acoustic remote sensing means to better understand the dynamics and three dimensional temperature structure of the ocean. Recognizing that potential, as Dr. Baker and Dr. Oswald indicated, the Navy has supported various R&D projects using IUSS assets, such as the Heard Island Experiment, the Acoustic Thermometry of the Ocean Program, marine mammal monitoring, marine seismology, and fisheries law enforcement. Descriptions of these applications have been provided by other witnesses, as well as in my written testimony. It is important to note that Navy has undertaken these cooperative efforts by making special security arrangements where necessary and on a not-to-interfere basis. We have cleared scientists and provided them with access to selected elements of IUSS in accordance with strict security guidelines.

It is fairly obvious that IUSS capabilities are a focal point for dual use and the various activities being pursued indicate the great potential of this resource. For sake of clarification, I would like to point out that IUSS is an operational system with resource sponsorship coming under the direction of the Office of the Chief of Naval Operations and program management under the direction of the Naval Space and Warfare Systems Command. In short, this is a success story with credit going to all those involved in supporting and demonstrating the use of this Navy asset.

The Navy will conduct the first undersea Arctic science cruise for the U.S. Science community at the end of this month. Five civilian scientists will get underway in USS Pargo (SSN–650) for 19 days. Forty-five experiments in the areas of global climate change, geological evolution of the Arctic Ocean basins, movement and changes of the permanent ice pack, and the Arctic Ocean's biologi-

cal and chemical environment are planned. This exercise, known as Submarine Arctic Science Cruise–93, is the first U.S. Nuclear submarine cruise totally dedicated to Arctic science exploration and represents a unique cooperative effort between the U.S. Navy and the U.S. Science community.

Since the Arctic Science Cruise–93 is primarily a non-military venture, the Navy does not have similar projects planned or funded. The Navy is willing to pursue making additional platforms available for research in the Arctic, but we are unable to immediately commit to future projects without the consideration of additional funds.

Interagency Committees and cooperative agreements are the primary mechanisms in place which facilitate the dual use of Defense technology. These activities include Navy involvement in the U.S. Global Change Research Program, the Interagency Working Group on Data Management for Global Change, the Office of the Federal Coordinator for Meteorological Services, the Federal Geographic Data Committee, the Defense Hydrographic Initiative and the Navy-NOAA Joint Ice Center. In addition, the Oceanographer of the Navy serves as the Naval Deputy to NOAA, thereby ensuring close ties between the two organizations.

In summary, Mr. Chairman, I appreciate the opportunity to address the Committee today. During the past few years, we have pursued new and exciting opportunities with the civilian oceanographic research community in the dual use of unique Navy technology and assets insofar as mission and security considerations permit. I believe the results of these collaborative efforts should be viewed as outstanding successes that provide new capabilities and data leading to a better understanding of various oceanic processes and marine mammal behavior.

This concludes the oral summary of my testimony. A complete written statement has been provided to the Subcommittee. I will be happy to answer any questions you may have at this time.

Mr. Ortiz. Thank you.

[The prepared statement of Mr. Winokur can be found at the end of the hearing.]

Mr. Ortiz. Dr. Baker, I know that you have other commitments and will probably have to leave. But we will submit to you a series of questions from the members, some of whom are with us today and some of whom could not be here. If you would like to leave a member of your staff to sit at the table, please feel free to do so.

Mr. Baker. Thank you. Dr. Ned Ostenso, who is head of our Oceanic and Atmospheric Research Division, is here; and he will take my place at the table.

Thank you very much.

Mr. Ortiz. Thank you for being with us, sir.

Dr. Hartwig.

STATEMENT OF DR. ERIC HARTWIG, DIRECTOR OF OCEANOGRAPHY, NAVAL RESEARCH LABORATORY

Dr. Hartwig. Thank you, Mr. Chairman.

I am testifying on behalf of the CNR, the Chief of Naval Research; the head of the Navy's science and technology organization.

It has both a extramural funded component going to universities and industry, sponsored by the Office of Naval Research, and an intramural activity, the Naval Research Lab located here in the District of Columbia and also in several other locations, Monterey, California, Stennis, Mississippi, and Orlando, Florida.

I am talking about what you would view as basic research and exploratory development efforts that go on within the Navy which is under the purview of the Chief of Naval Research. It includes a broad spectrum of environmental parameters, both in the ocean and in the atmosphere, not just oceanographic research internal to the ocean.

As we talk about dual use and cooperation, I was noting as I came in and saw the gentlemen sitting down, my colleagues here, that among us, we have decades of interaction and collaboration in different capacities.

Myself, I have been in private industry, universities, as well as with the Federal Government. The same is true for other people here. So we have a lot of interactions that occur all the time because we know each other and we talk to each other. I think that is very important in terms of a mechanism of getting information exchanged and developing programs.

Right now I think the Navy oceanographic community, as well as the rest of the community, is involved in a fairly grand challenge; and that is: Can we observe and understand and predict the ocean and atmosphere behavior at time and space scales, at least for the Navy that is important to the mission that the Navy is doing.

Everything that the Chief of Naval Research is doing, as a mission agency in direct support of Navy operations and missions and for the safety of the platform and the people involved.

Sometimes we have a dichotomy when you go from a technology that was developed for a very specific purpose to something that is now going to be used by someone else. Usually that requires, just like in private industry an investment by the recipient. If you think about it, someone develops a technology and then industry wants it; therefore, some company comes forward and applies for a patent license, invests some R&D money to get it useful for their product, and goes out and uses it for their own purposes.

I think the same thing is true for most DOD technology. It is developed for a particular purpose. And, therefore, it needs to be thought about in terms of how do you convert the technology—and it usually does take investment of R&D resources to convert it—to use it for something else? It is just not a turnkey operation where you can sit down, turn it on and go use it. It takes some effort to get going on it.

You have heard a lot about the Integrated Undersea Surveillance System, IUSS and the SOSUS arrays that are a part of that. NRL scientists were players in that. There is a facility sitting across the bay here in DC that was put together with Navy sponsorship through the CNR'S facilities to allow the outside community to come in and use these facilities.

There was a recent press conference on this where Dr. Chris Clark from Cornell University, who is working with these facilities stated; and I agree with him, and the people that were there that it is going to revolutionize marine mammal research. They detected

more in six weeks than the entire previous record of marine mammal detections.

So it really is a phenomenal capability. It is not easy. You don't just sit down and see the marine mammals. To get this to be useful for a marine mammal capability is going to take some concentrated effort because the Navy has spent most of the time, of course, getting rid of those signals, and now we want to detect those signals. So it is a different kind of approach to use for the problem.

Another scientist at the press conference was Dr. Clyde Nishimura, who is a NRL scientist. He was discussing detection of seismic events like Dr. Baker was talking about. He noted, at that press conference, which I personally found phenomenal, that they detected hundreds of seismic events in a period of time with the underwater sensors, where with the land-based sensors, in the same period of time, they detected 10.

If you are interested in the geophysical processes that lead to seismic events and you are interested in the formation of the ocean crust, that is the kind of measurements and data stream you need. Statistically, with 10 events a month, you will be sampling a long time. Statistically, hundreds of events a month really gives you an advantage in terms of data that you can get. In addition, you can actually locate where these seismic events occur.

There are also untested potentials, as other members of the Committee have pointed out. They have not been demonstrated, unlike in the marine mammals and the seismics efforts.

One is an acoustic telemetry from underwater sensors. For example, if you have a drifter that is floating through the ocean and it sends out an acoustic signal which, if you could detect where it is and when it is there, you could calculate its velocity and trajectory in the ocean. This would be useful for a lot of physical oceanographic studies tracking subsurface ocean currents.

You can also use it potentially—and this is a potential—if you had moored systems under the water, you could actually transmit moored data acoustically to the IUSS array and pick that data up and have it in the lab in real time.

As Mr. Winokur was talking about in the acoustic thermometer experiment that ARPA is sponsoring, it has potential there to be used directly as a sensor. If you can extract the data correctly, you can actually extract the temperature of the ocean over a long range and actually detect global warming if you have it out there long enough.

I think another possibility is in the global ocean observing system which is an international effort that the U.S. is involved in. This technology has a potential to be used as a focal point—at least in the areas where it is located, it is not everywhere—to be used as a component of the Global Ocean Observing System.

Let me quickly move to another technology. Let me pick up one other example. There is a lot more in the written testimony I provided.

Ocean and atmospheric modeling and simulation: This is an area in which the Navy has an absolute requirement to be able to tell its war fighting units what are the environmental conditions going to be like so we can fight smarter and safer when you are there. You have to be able to forecast the environment in front of you.

You need not only "now casting" where you will be "now," so if you are going to launch an aircraft you know what the conditions are; but you must also be able to forecast the near future.

There is a system which I find very interesting, called NEONS, which is a Navy environmental operational forecasting system. This is a data base management system that was a commercial product that NRL picked up out in Monterey under sponsorship from the Oceanographer of the Navy. By not reinventing the wheel, NRL used that technology, enhanced it for the capability that the Navy needed, transitioned it to the Navy so the Navy is now using it, and now has transitioned it to NOAA. It is now in all three NOAA global change program sites.

So here is an example of a technology that came out of commercial, was invested in and enhanced by DOD, and then provided by the Navy to NOAA and the civilian sector because it is a very good product.

There is also, at this point, untapped capability, I think, in the Navy's ocean modeling capability. The Navy has a requirement to model the ocean. I think there is a vast pool of capability existing in the Navy's S&T community (Science and Technology community), to provide benefit in a dual use way to other agencies and to the civilian community.

Overall, I would like to leave the impression with you that the S&T community of the Navy has long been involved in transferring technology to many agencies, out to the academic community; and I think it has been appreciated. It has been both ways. When we have done something in the Navy that has been of benefit to other agencies, we have gotten benefit back. Data generated by NOAA goes directly back to the Navy. So any kind of capability we generate comes back to us, also.

Thank you, Mr. Chairman.

Mr. Ortiz. Thank you.

[The prepared statement of Dr. Hartwig can be found at the end of the hearing.]

STATEMENT OF DR. KENNETH T. DAUGHERTY, DEPUTY DIRECTOR, DEFENSE MAPPING AGENCY

Dr. Daugherty. Thank you, Mr. Chairman and Members of the Committee. I am happy to be here representing the Defense Mapping Agency, or DMA, to talk to you about dual use of technology, assets and programs.

DMA was established in 1972 out of the Mapping, Charting and Geodesy elements, or MC&G, of the services. We were designated as a Combat Support Agency under the Goldwater-Nichols Act of 1986. We provide, under our normal charter, the mapping, charting and geodesy for the Department of Defense and other Federal agencies, generally outside the United States and its territorial waters.

We also have a statutory responsibility under Title 10 to provide nautical charts for public sale worldwide to support the maritime industry of this country. We coordinate the kinds of products and services we provide with the military departments, and we get our specific requirements for the things we must produce from the Uni-

fied and Specified Commands based upon their responsibilities and the missions they are given.

Priority for our production is determined by those Commands and the Joint Staff in terms of the immediacy of the mission and the risk of failure if they don't have those kinds of products.

We have a history of cooperation with NOAA and with its National Ocean Service. Whereas NOS produces the charts of the U.S. waters, we produce the charts of the foreign waters to support all of this country's activities.

NOS sells us, for our DOD customers, NOS charts of U.S. waters, at the marginal cost of production and distribution. We do contribute annually over $13 million to the maintenance of NOS's chart data base, and we purchase charts from them. Last year we purchased about $970,000 worth of nautical charts from NOS for use by DOD customers.

We have incorporated the NOS and the DMA chart corrections into our weekly Notice to Mariners. We use the NOS agency sales network to distribute our public sale products to the civil mariner. We are in charge of two of the 16 navigational warning areas in the world for the radio broadcast of hazards to navigation.

We usually rely on the Navy to survey for us in foreign waters. If they are unable to do it for whatever reason, we have turned to NOS and have contracted them to do surveys as DOD did in the Nicaraguan Rise back in the middle 1980's.

If a survey requirement is in U.S. waters to support Navy, we will ask that NOS do it. If they can do it on their own resources, fine; if not, we have transferred money to them to do surveys. We do think that they ought to have access to something like the Harbor Maintenence Trust Fund in order to have more resources to do that kind of activity in response to DOD needs.

We are now discussing with NOS two projects. One is the establishment of a real-time system for tidal current forecasting in specific ports for the Navy home-porting needs and the other is detailed surveys of safe areas for coastal training where the Navy is preparing to take on its new role in littoral warfare.

I would like to talk about two things that we do in cooperation with NOS. One is the Digital Nautical Chart Production Program. The Digital Nautical Chart Production Program is a move by the Navy to go to a paperless navigation system on board ships. And we, with assistance from the NOS, are converting about 4,000 coastal and port and harbor charts from paper to digits in a vector product format.

NOS, with some additional funding from us, shared funding, has taken on their area of responsibility; and they are turning those into digital products for us. Those 4,000 charts will be done by the end of 1997. The cost has been about $8 million DMA has invested, and that is shared between the two of us. This allows NOS to go to a digital nautical chart for the U.S. maritime industry.

The other thing is the Defense Hydrographic Initiative, which is a cooperation between DMA, NOS, and Navy to improve the management of our hydrographic and bathymetric holdings and prepare for more accurate chart production in the future. We are expecting some results from that in 1997, and they will be shared across the three elements.

The last item on shared technology is the Digital Sounder or a Hydrographic Data Recording System we have designed. This is a carry-on, carry-off suitcase system which has a standard computer monitor, an accurate Global Positioning System receiver, and a mass storage device that can plug into a standard depth-finder transceiver on board a ship, record automatically the depths where that ships transits and then can be carried off at the end of the voyage to go home. We see that being deployed as shortly as 1995 on U.S. naval vessels, but there is no reason why it cannot go on to NOS, Coast Guard, or civil vessels.

In summary, sir, the DMA has a tradition of cooperation with NOAA, NOS, and other Federal agencies. We think that partnership has resulted in sharing of data and assets beneficial to Defense and the civil community. And we think there is significant opportunity for future cooperation.

Thank you.

Mr. Ortiz. Thank you.

[The prepared statement of Dr. Daugherty can be found at the end of the hearing.]

Mr. Ortiz. Dr. Schmitz.

STATEMENT OF DR. WILLIAM SCHMITZ, CLARK PROFESSOR AND SENIOR SCIENTIST, WOODS HOLE OCEANOGRAPHIC INSTITUTION

Dr. Schmitz. This is my first time to testify before a congressional Committee. If I seem a little nervous, it is because I am.

I am not a member of the government. I am an academic research oceanographer. I have participated in a number of dual use technologies, spin-off, spin-on type situations. I am also, thank God, not the director or chairman of anything. I actually use this stuff.

Some of the applications that they have mentioned I have been personally involved in, for example, using SOFAR floats as acoustically current-tracking floats. The SOSUS network will really help there, also for acoustic telemetry.

The gentlemen from the Corps of Engineers, I think we are using his computer right now at Vicksburg. I am connected with the ocean modeling effort that has been mentioned. As far as I can tell, all of the basic research and applied research results at the working level are fully transferred across all of the government agencies. I know of industry also participating when they are interested; there is no real problem in oceanography in that regard.

Some of these technologies have been classified, but they are becoming declassified. I think, looking at the title of this Committee, the bigger problem perhaps—and it was referred to by the gentleman from HASC—is other aspects of defense conversion.

I was on a panel this summer called the Naval Research Advisory Committee Panel on Defense Conversion. There is a report out now, or soon. We looked at all possibilities. The biggest problem, I think, that we are facing with Defense conversion as a Nation is really market pull. Most of the agencies are going to be cooperative. With regard to market pull and the technology that perhaps as a Nation we certainly want to try to maintain preeminence in, shipbuilding, the national shipbuilding initiative is very important.

I would think that there is a place where, if we could have a shipyard that made both merchant vessels and naval vessels and did it with the latest high tech, I think that would be great for our country. There is a lot of work there. But if you use really new technology maybe you could be competitive internationally.

There are a lot of ways that government labs have been using to get involved in technology transfer. The NRL has done very well. Patent licensing, I think that should be pushed. There is something called a CRADA. I am not an expert on the rules on that, but some people like CRADAs. Sandia likes CRADAs.

I feel that the United States is the leader in oceanographic technology, and the world leader in physical oceanography. And there is no major problem with that I know of right at this minute.

I will stop while the light is green. You can tell I am not directing anything.

[The prepared statement of Dr. Schmitz can be found at the end of the hearing.]

Mr. Ortiz. We have had some very interesting testimony this afternoon. I think there is a tremendous amount of potential here. We have at least three Members of this Subcommittee who are Members of the Armed Services Committee. I think this is a subject that is of great interest to us.

We have been joined this afternoon by the Ranking Minority Member here, a good friend, the distinguished gentleman from Pennsylvania, Mr. Weldon.

Would you like to address the witnesses?

STATEMENT OF HON. CURT WELDON, A U.S. REPRESENTATIVE FROM PENNSYLVANIA

Mr. Weldon. Thank you, Mr. Chairman.

First let me apologize to each of you for not being here at the beginning. But we have a very hectic week going on, as you know. Being on both the Merchant Marine Committee and Armed Services Committee, we are about to begin the general debate on the 1994 Defense Authorization Bill today. So I have been tied up in preparing for that. I apologize.

I will read all of your testimony. I have looked at the analysis of the statements you have made. I am very much interested in finding ways that we can help you all achieve a higher level of what you are already doing, and that is sharing information and looking at ways that we can benefit from dual use technology and share the research and ongoing activities of the military with the commercial and private sector.

Mr. Hochbrueckner and Mr. Ortiz, our Chairman, sat through the hearings; so I will defer to them for initial questions. I appreciate you all coming in. This will be the beginning of an ongoing dialog as we get into Defense conversion very heavily as the Defense bill moves through the Floor and through the process of the Congress.

Mr. Ortiz. Thank you.

We have also been joined by my good friend from the small city of Houston, Texas, who is a Member of the Committee here.

Would you like to address the panel of witnesses, Mr. Green?

Mr. Green. I also want to apologize for not being here earlier. It was not lack of interest, because the impact of sharing technology for—even though we come from a small city, we have a large port and the sharing of that information between private industry and military is so important.

I would hope that even during the questions and answers we can see how we can expand even more of the sharing that has been going on for many years.

Thank you.

Mr. Ortiz. I know my good friend from New York State, this is his area of expertise. I would like to refer now to Mr. Hochbrueckner, to see if he has any questions for the panel.

Mr. Hochbrueckner. Thank you, Mr. Chairman. Actually I will be brief in light of the time constraints.

Dr. Baker, on the Pacific Marine Environmental Lab Program, in essence, where you capture data and real time data link it back to Oregon to the lab, are you doing high speed processing on that data at all in order to detect the seismic activity with volcanos and what have you?

I wondered if you are into any parallel computing activity through that facility?

Dr. Ostenso. I am answering for Dr. Baker in his absence. My name is Ned Ostenso. I am Assistant Administrator for Research.

We are not doing parallel processing on that data now. We are developing a parallel processing capability within our environmental research laboratories. The level of processing of these data we are doing now is very primitive. The signal that we get is very robust. We can at least locate and determine a lot of information with a primitive signal processing we have.

If we had all the censors of the array channeled into the laboratory and had a more sophisticated data processing capability, then we could find out a great deal more information of what is going on.

We are just at square one of this whole experiment. As my colleague from NRL pointed out, in the transfer from government to industry or from defense to civilian products, there are substantial investment and conversion that has to go on. We are prepared to make that investment because we see its value is so great. But right now the processing is primitive.

Mr. Hochbrueckner. Then let us know when you are ready to get into high speed stuff, and we will tell you who to go talk to with parallel processing.

Dr. Ostenso. Very good. I would love to do that.

Mr. Hochbrueckner. Dr. Hartwig, in your testimony you wrote, although you didn't speak about it, but you wrote about the airborne electromagnetic bathymetry system. I was wondering, would that be useful, in essence, from moving hazards from waterways?

It seems to me from the way it was written up in your testimony that you should be able to defect underwater submerged articles, especially where we have had flooding and we are trying to figure out where we ought to be removing and sensitive to things from the navigation point of view.

Dr. Hartwig. I cannot say specifically. It has been used by the Corps of Engineers to locate varied remnants in the flood control

structure that are metal. If there is something there that will interrupt or distort the electromagnetic field that the sensor is sending out, it should be able to detect it, within a certain range.

It cannot be very deep because the signal is not very strong. It only goes down, I think it is around 20 to 30 meters maximum depth. But if it is within that range and it has that characteristic length scale of several meters, then the potential is there for sure to be able to detect some kind of a structure like that. If it is an object that does not distort the electromagnetic field, then it would not detect it.

Mr. HOCHBRUECKNER. Then it is a spin off of the Magnetic Airborne Detection Capability System we have had for a long time.

Dr. HARTWIG. That is right.

Mr. HOCHBRUECKNER. Thank you very much.

Thank you, Mr. Chairman.

Mr. ORTIZ. Let me ask one question, and then I will refer to the gentleman from Texas, Mr. Green.

A recurring theme throughout the testimony is that of security in terms of ocean models and data. I would like to know what are the security concerns and why is certain data not released or released after a waiting period.

Maybe there will be a need that maybe you all could not discuss some issues or items that you would like to discuss because it is classified. I would like to ask the entire panel to see if you can answer that question. Maybe there is a need for this Subcommittee to have a classified briefing.

Mr. WINOKUR. Mr. Chairman, I will attempt to answer that first, and then my colleagues can join in as appropriate. We would be pleased to provide you a classified briefing if you think it is appropriate.

Most of the security issues we deal with oftentimes really represent security of the forces that are actually collecting the data. For example, if data are being collected from operational ships for a certain period of time, we have to protect where those ships are operating and in particular the type of data they are collecting.

After a certain period of days, such as 30 days, as I mentioned in my testimony, we will release that data. So part of it is an operational security issue.

With respect to some of the other kinds of data, acoustic data, for example, there are particular sensitivities with respect to the application of that data to anti-submarine warfare systems and the location of the data because of the uniqueness. For example, if you were collecting data in the Persian Gulf or someplace like that.

So some of the data is, in fact, then tied directly to systems applications, anti-submarine warfare systems, strike warfare systems, mine warfare systems, and other applications that really have to do with the day-to-day operational security.

Dr. OSWALD. Oftentimes the issue is also the capability of that system. So when you release the data, you want to make sure that you do not tell our enemies the capability in terms of sensitivity and finite. So part of the releasability is ensuring that we are not revealing the ultimate capability of our system so that they have can be circumvented.

Dr. OSTENSO. This is such a complex issue, there are lots of reasons in addition to those which have been mentioned. There is the issue of international accords with other countries, et cetera.

I think that the real issue here is whether there is a serious effort being made to relook at the classification that was done on the Cold War standards and reassessing it in light of the new world. Yes, a substantial effort is being made.

This is a horrendous undertaking, just looking at the quantity of data, the ground rules for doing it have to be redrawn. Teams have got to be reorganized, and the process is going on.

From a civilian, unclassified agency point of view, I am very comfortable with the effort that is going on. I am very comfortable with the attitude the defense and intelligence agencies are bringing to the table. I think that an appropriate readdressing of the problem is being done. I think it is being done in a very positive mindset.

Mr. ORTIZ. If we don't have any further responses to that question, I will like to now defer to my good from Texas, Mr. Green.

Mr. GREEN. Thank you, Mr. Chairman.

This is for any of the panelists. I would like to ask how successful the Navy or NOAA has been in identifying and locating undersea volcanos and earthquakes in using the Navy's Integrated Undersea Surveillance System; and, in light of that, also some of the shortcomings of our nautical charts?

In one of your testimonies, I noticed that you talked about that; and in using your charts, you talk about the Queen Elizabeth off Cape Cod.

Sometimes we hear complaints in our offices about charts are not as accurate as they should be. I think that is the concern coming from a major seaport. The first one is about the Navy, NOAA, and the volcanos.

Dr. HARTWIG. If I could speak a little bit, and I am sure Dr. Ostenso could say a few words also. It has been very successful. As Dr. Ostenso said, it takes a lot of effort to extract the signal because it was not set up to detect those.

In a six-week period of time, when the experiment was going on and data was coming in over to the Naval Research Lab and with outside scientists involved as well as internal Navy scientists involved, they were detecting in the North Atlantic Ridge area, hundreds of seismic events in a month versus ten seismic events from land-based sensors. It detects and locates where those events are occurring.

The analysis of what that means is still going on. As I was saying earlier, the data rate is so much higher than we have ever had before for looking at underwater seismic events, it is going to make a change in our understanding of geophysical activities that lead to seismic events and also on understanding the formation of the crust of the ocean at these locations like the mid-Atlantic ridge.

So it can be done, but it takes a lot of effort right now because it was not designed to do that. But it is being used to do that right now.

Dr. OSTENSO. Another way of expressing that is that on land, we have very few sensors, whereas in the ocean we have many. The capability of a land sensor to detect an ocean bottom volcanism is

about 4.5 on the standard Richter scale, which is a logarithmic scale.

Using just one ocean sensor with primitive data processing, we are now down to a detection sensitivity of about 2.4.

The people in the business believe that with a little more sophistication and more channels coming in, you would get down to two. So that is an enormous improvement.

What we can look at now is essentially the heartbeat of the earth instead of just observing cataclysmic events as we have had to in the past.

So if you take a medical analogy, I suppose it is like the difference of being able to measure the heartbeat versus waiting until the patient goes into spasms. It is really very dramatic.

Mr. GREEN. That is a good analogy.

Dr. DAUGHERTY. Let me speak to the charting question you had, sir. We are concerned that much of the base data that is under, I would say, roughly, 50 percent of the NOS charts in U.S. waters, collected before World War II, with lead line measurements and wire drag kinds of technology. With deep-draft vessels, as was illustrated by the QE–2 grounding, areas that you would think are well traveled and well known can still pose hazards to navigation in today's age. The technology exists in terms of swath width acoustic-sounding devices and surveys to rectify that, but the National Ocean Service does not have the resources to go out there and run the vessels over the area and collect that data.

We believe that it does pose risk. And as ships go to deeper draft, we will see more risk to vessels in U.S. waters because of that shortcoming in basic survey data.

Mr. GREEN. What would you suggest for us to—and obviously, it is resources. And this week particularly, we recognize the limitation on our resources. But you know, to improve that, because with the deeper-draft vessels—and again the problem in the Gulf of Mexico is normally man-made, from some of our structures we leave there, or is left there, whereas I know in other places it is because of the topography.

Dr. DAUGHERTY. So there is no cheap and simple solution, because even with the swath surveys you have got to go out there in a vessel and occupy the space and collect the data. But I think that my recommendation would be that you ask the National Ocean Service to look at the application of the latest technology and tell you what it would cost this Nation to put that data base in shape to support our nautical requirements into the next century. It is long overdue, sir.

Mr. GREEN. Thank you.

Thank you, Mr. Chairman.

Mr. ORTIZ. Mr. Hochbrueckner from New York, do you have another question?

Mr. HOCHBRUECKNER. No, I am finished.

Thank you.

Mr. ORTIZ. I just have one more question, and this is for the entire panel. Several of you mention in your testimony that you have been involved with the Environmental Task Force. If you could tell us a little bit more about what it does and the way it is developing, anybody that can answer that?

Dr. OSTENSO. I feel a little bit constrained in answering your question. The existence of the Environmental Task Force is quite well-known. It is an effort to bring together the defense and intelligence agencies with the civil scientific community, to identify the opportunities for conversion and co-use. There are about 60 people, all of whom are there by virtue of their individual expertise. They are not there representing an organization.

In an effort to protect their privacy, because as you can imagine, this is quite a popular thing, a deliberate effort has been made to keep the membership of the task force rather closely-held. The list as a whole, has not been widely distributed.

In this long answer, the process is for the agencies to sit down with the research communities in all sectors and to quietly work out where areas of common and mutual interest are. This has been a very, very open process, open in the sense that the exchange has been free, nothing has been held back from the research community, and we are in the process now of collating all that data and coming up with a report.

Mr. WINOKUR. The only thing I would add, and I agree with Doctor Ostenso's comments, is that the Navy as well as the other defense agencies have been cooperating fully with the Environmental Task Force, and what I would suggest is that an appropriate briefing be provided to you and members of the staff by the Chairman of the task force who is better suited to really address what is happening with the task force directly. But clearly, all of us here are supportive of it and we have been participating fully, and we could certainly pass on your interest in the task force to the Chairman.

Mr. ORTIZ. Yes, sir. Another area that I am very interested in is the commercial value and the potential that we have, and I know that several Members couldn't be here with us today because we are trying to get this reconciliation package out by Friday. Otherwise, we stay here a month. But I think that there are several members who have different questions that they would like to submit for the panel, for the record. So that you can answer that, they will be included for the record.

[The information can be found at the end of the hearing.]

Mr. ORTIZ. Anybody else who would like to say something?

We have a vote now in process, and we may have a series of votes later on.

This concludes the testimony for this panel today.

I want to thank you for the valuable testimony and insights that you have shared with us today. We will submit those questions to you, and I can assure you that this Committee, the Subcommittee Chairman, and the Members of this panel would like to work with you, and I know that together we will continue to be the leaders in oceanography throughout the world.

Thank you very much for being with us.

[Whereupon, at 3:45 p.m., the Subcommittee was adjourned, and the following was submitted for the record:]

TESTIMONY OF
DR. JAMES BAKER
UNDER SECRETARY FOR OCEANS AND ATMOSPHERE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE
SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO
AND THE OUTER CONTINENTAL SHELF
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES

AUGUST 4, 1993

Mr. Chairman and members of the Subcommittee:

The National Oceanic and Atmospheric Administration (NOAA) sincerely appreciates the opportunity to testify on this most important and timely matter. We believe the dual use concept offers potential for fundamental advances in many aspects of ocean research generally, and to NOAA missions specifically. The "eyes and ears" developed and operated at considerable expense to help defend our Nation can give us an unprecedented view of our own ocean environment - - three-quarters of the Earth - - potentially improving our management of living marine resources, prediction of natural disasters, knowledge of climate change, and information on a host of other critical issues.

Much still must be done to prove this potential. Some significant steps have already been taken, and many scientists feel the promise is good. We must now: (1) identify the systems and technologies most likely to have environmental applications; (2) test and prove the most promising concepts; (3) resolve security and classification concerns about civilian use; and

(4) establish mechanisms and resources for dual use operation. Each application will have unique circumstances, but we believe that close cooperation with the Department of Defense, other federal agencies, and the civilian academic community can make this work.

Various interagency panels and working groups are now engaged in the first step. NOAA has participated in preliminary projects and anticipates more in the future. A process is already working. With encouragement, it will succeed.

Integrated Undersea Surveillance System

Several exciting applications involve the Navy's Integrated Undersea Surveillance System (IUSS). This system is designed to locate and track ships and submarines acoustically. For several years now, NOAA scientists at our Pacific Marine Environmental Laboratory (PMEL) have been working with the Navy to use the system as a research tool in their Vents program. Their emphasis has been to detect, locate, and describe hydrothermal activity throughout the North Pacific Basin. Additional NOAA scientists at the National Marine Mammal Laboratory have identified and located endangered whales in the North Pacific using IUSS information. The work has proven very successful, both as good

science and as a demonstration of NOAA/Navy cooperation. In fact, this collaboration has been a stimulant for NOAA to seek other uses of the IUSS.

The PMEL project has evolved over several years to where it now uses a realtime data link from the Navy to NOAA's facility in Newport, Oregon. There, the raw acoustic data are processed to detect signals from volcanic and seismic activity. In a dramatic success, this link detected and located a below the surface volcanic eruption just as it started a few weeks ago. A research ship in the area was alerted and sent to the location. It was able to collect rare water samples at the event. This type of quick response to a rare event, and the monitoring of more frequent hydrothermal venting events would only be practical with dual use of the IUSS.

Other significant IUSS applications have been proposed as well. These include:

- assessing global warming by measuring bulk ocean temperature using acoustic tomography techniques;

- monitoring marine mammal (e.g., endangered whales) behavior, migrations, and assessing population sizes and distributions;

- monitoring and detecting driftnet and other fishing activity in the North Pacific and elsewhere;
- assessing fisheries stocks in EEZ waters;
- transmitting data from and geolocating drifting mid-water instrument packages; and
- measuring open ocean rainfall rates.

Demonstration projects for the first three - - global warming, marine mammal studies, and driftnet fishing - - have been or soon will be carried out. Several were funded through the Strategic Environmental Research and Development Program. Although NOAA is not directly involved in some of these, their results may point the way for other long-term applications. The remaining three proposals have not been tested, but appear technically feasible and worth further study. The IUSS system clearly offers the potential for a range of civil applications, and NOAA strongly supports its dual use.

Ships

NOAA and the Navy are cooperating in identifying ships that can be utilized for civilian missions. NOAA has received three former T-AGOS surveillance vessels for conversion to meet

specialized NOAA oceanographic and nautical charting mission requirements. NOAA will continue to investigate the feasibility of using surplus naval vessels to fulfill specific NOAA mission needs.

Over the Horizon Radar

Another system for possible dual-use is the Over The Horizon (OTH) Radar, built for the Air Force. This system uses an ionospheric bounce of low-frequency radar to provide early warning of aircraft attack. Its potential application to ocean environmental studies arises because the returning radar signal is modulated by ocean wave conditions. Although this "sea clutter" is rejected when tracking aircraft, the information can be recovered by special processing.

Scientists from NOAA's Wave Propagation Laboratory have demonstrated the ability to extract surface wave and wind direction data over large ocean areas. They believe it will be possible to extract wind speed and wave height as well. Applications of such data include observations to improve significantly synoptic scale modelling and weather forecasts in data sparse ocean areas. And a dramatic test during Hurricane Andrew last year demonstrated the ability to track these storms continuously in conjunction with satellite data as they approach the coast.

NOAA remains involved in an interagency task group exploring uses of the OTH radar. Because the Air Force already has decided to mothball the system, significant funding would be needed for continuing operations. Multiple agency participation for a variety of missions appears the only feasible option. We do not know what the outcome will be of the interagency task group, but remain hopeful that a cost-effective mix of missions may be found.

Other Classified Surveillance Assets

The defense and intelligence agencies also operate other highly classified assets. This category includes assets producing what is called "satellite imagery" in the civilian community. Although we cannot provide further information about classified assets in this forum, NOAA is participating with others in the Environmental Task Force process to identify potential applications for beneficial civilian purposes.

As an example of processes to implement dual use, there was legislation in 1992 directing use of intelligence assets to support enforcement of driftnet fishing regulations (the High Seas Driftnet Fisheries Enforcement Act, Public Law 102-582). In this case, NOAA and the intelligence agency involved are in the process of establishing a separate Memorandum of Understanding. The application has proven very successful, and provides a

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capability we simply could not afford to match with more traditional ship and aircraft patrols.

The Department of Defense also cooperates with NOAA in providing access to, and use of, the Defense Meteorological Satellite Program (DMSP) data. For example, the Special Sensor Microwave/Imager data is used by NOAA researchers to study the soil wetness, precipitation, and similar subject's index. NOAA recently provided this data to the Vice President for his Midwest "Flood" briefing. NOAA participates in the shared processing data network for the exchange of meteorological satellite data and products. Also, NOAA provides the archive service for selected DMSP data sets.

Conclusions

NOAA strongly supports the concept of dual use for environmental purposes. A period of testing is needed to prove the value of each application, but the process should go forward.

Dual use implies civil access to environmental data. We feel NOAA can contribute significantly to the conversion for civilian use of defense and intelligence assets and their historic data.

Except for ships, NOAA believes that these assets should be operated in their parent agencies, preserving the integrity of the assets for defense applications. Dual use, however, would also allow the assets to be used to preserve our Nation's environmental and economic security. This is an important goal and one in which our defense-related assets can offer valuable contributions.

Thank you, Mr. Chairman. This concludes my testimony. I would be pleased to respond to any questions from you or other members of the Subcommittee.

Dr. Robert B. Oswald

U.S. House of Representatives
Committee on Merchant Marine and Fisheries
Subcommittee on Oceanography, Gulf of Mexico, and the
Outer Continental Shelf

August 4, 1993

Mr. Chairman, I am Robert B. Oswald, Director of Research and Development for the U.S. Army Corps of Engineers. Other positions I currently hold include: Chairman of the Joint Engineers Management Panel of the Tri-Service Reliance, and the Executive Director of the Strategic Environmental Research and Development Program. I am pleased to be here today to present testimony on the dual use of Defense technology for oceanographic research.

I'd like to start out by stating that I am not an Oceanographer. But, I speak to you today primarily in my capacity as Executive Director of the Strategic Environmental Research and Development Program -- also known as SERDP. SERDP is a Congressionally directed program which focuses Department of Defense research assets towards solving environmental issues. Under SERDP we have an effort on global environmental change which uses oceanographic technology. SERDP is driven by the concept of Dual Use technology. One of it's principle purposes is to apply DOD technology to nonmilitary, research use.

BACKGROUND

Technical capabilities for observing the environment on a global scale have improved rapidly, especially in the area of remote sensing. New and highly capable national and international civil sensor systems are being developed. The Earth Observing System (EOS), for example, will vastly expand our knowledge of the global environment. Nonetheless, technology and cost tradeoffs have limited the civil community to a subset of the full range of sensor system characteristics. The classified community, focusing on collecting data of national security interest, has also developed a limited sensor set. Thus, the two worlds - civil and classified - have developed different but complementary measurement capabilities. This complementary nature suggests that classified assets could extend, enhance, and, in some cases, enable measurement of scientific parameters of environmental importance.

OCEANOGRAPHY AND REMOTE SENSING

Environmental ocean science is a discipline that tends to be data starved, with progress springing out of new measurement opportunities and new ways to think about data. A variety of classified sensors and datasets offer the prospect of greatly

expanding the boundaries of ocean science. In some cases, the approach to using the data or capability is very clear (e.g., GPS precision navigation data). In other cases scientific use of classified data seems at least plausible (e.g., the use of high-resolution imagery to study convective chimneys - vertical transport of seawater within kilometer-sized convective cells). In still other cases, we can only speculate about the possibilities without yet understanding what can really be done (e.g., the quantitative estimation of marine mammal stocks using undersea acoustic systems).

Ocean research, in general, focuses on phenomena characterized by a wide-variety of spatial scales ranging from small scale and mesoscale, to basin and global scales. On the other hand, many intelligence and defense sensor systems focus on processes characterized by very small spatial scales. There are often differences in temporal scale as well, with many classified assets concerned with short term-changes. Oceanography, by contrast, has interest in a broader range of time scales, involving processes having time scales ranging to decades (e.g., global ocean warming).

Ocean studies generally rely on lengthy time series of observations to understand the effects of low-frequency variability in the temporal domain. Undersea current meter records, for example, are usually one year or longer in duration. In the spatial domain, extensive observations from civilian satellites provide the global and basic scale view. These measurements must remain consistent and well-calibrated over a long time period and across an extensive spatial domain. Thus, the scientific focus is frequently on absolute calibrated, rather than relative, measurements of ocean variables. Single images at very high resolution can have great value for intelligence purposes, but this value decreases rapidly with age. For ocean science, time series of well-calibrated, consistent data are of tremendous value and are in short supply, especially for time periods extending over many years.

There is also a focus on small-scale processes in ocean science (e.g., beach erosion processes and census problems in marine mammal populations). Small-scale processes were much more consistent with the scales of interest in many intelligence applications. Further, because of the resolution and data rate demands of such systems it is unlikely that the scientific community will be able to reproduce similar assets. It is in this area of small-scale, real-time problems that the oceanographic community can most benefit from access to high-resolution systems. Some of these oceanographic problems occur in the deep ocean (e.g., bottom water formation in chimneys) but most are associated with coastal waters where the spatial scales of interest are inherently smaller. Optimum uses of classified systems for small-scale processes need to be more fully defined.

DUAL-USE APPLICATIONS

The Navy's Integrated Undersea Surveillance Systems

The Navy has an extensive undersea acoustic surveillance system known as IUSS (Integrated Undersea Surveillance System). IUSS includes the existing SOSUS (SOund Surveillance System) and SURTASS (Surveillance Towed Arrat Sonar System) systems, and future systems. Historically the Navy has found these systems to offer an important and unique window into long term monitoring of the oceans (submarine activities) which is complementary to other remote sensing systems.

Many of the applications of these acoustic systems to important scientific problems and public policy issues fall within the ocean monitoring responsibilities of NOAA. These include the difficult biodiversity and conservation problems associated with marine mammals, particularly the great whales. The IUSS systems offer the unique potential for ocean basin wide long-term monitoring of the activities of these mammals, and for obtaining credible estimates of changes in species populations.

In November of 1992, the Navy initiated a test of the Sound Surveillance System -- called SOSUS -- to track whales. SOSUS is a subsystem of IUSS which enables researchers to listen to the sounds made by undersea mammals. The results of the six month test were remarkable. At one site, the SOSUS made more detections of blue, finback and minke whales than were contained in existing data bases for all previous coastal whale studies.

The growing number of fixes on finbacks and humpbacks contradict much of the former scientific knowledge for the seasonal distribution of these animals. In the case of the humpbacks, it was believed that they were found in less than 100 meters of water. But the Navy documented humpbacks singing in deep water off the West Indies. IUSS enables researchers to do what they weren't available to do before -- to go offshore into deep water and listen for these undersea mammals.

The IUSS can also be used to monitor activities of fishing vessels possibly involved in illegal drift net fishing or in whaling banned by international agreement. Undersea acoustic systems can also provide the means for monitoring seismic activity levels along the mid-ocean ridges at detection sensitivities significantly better than the Global Seismic Network. These systems may also be useful or precisely geolocating sea floor phenomena such as hydrothermal vents and turbidity flows in preparation for in situ exploration with submersibles. These important applications are currently being explored by NOAA and by other scientists.

Through storage of heat and greenhouse gasses (e.g., CO_2), the worlds oceans play a major role in climate change. The transport of heat and gases between the oceans and the atmosphere are among the most critical dynamical processes at work in determining the resultant rate of global warming. At present, our understanding of the ocean storage and air-sea exchange of heat and gasses, and their global transport through ocean circulation is primitive, based primarily on current inference from theoretical models. The most critical need is for direct measurements of ocean temperatures over broad areas and long time periods. A project has begun to

determine if measurements of ocean sound speed over long distances can be made with sufficient precision and stability to allow bulk ocean temperatures to be extracted. This project, ATOC (Acoustic Thermometry of Ocean Climate), uses the Navy's SOSUS system as receivers of signals generated by distant sound sources. Measured travel times give average temperatures along acoustic paths integrated over distances of the order of 10,000 km. This three year project was begun by the Advanced Research Projects Agency (ARPA), under SERDP funding, to demonstrate the technique, with a long term measurement program expected to follow. The measurement results of ATOC will be assimilated into coupled ocean-atmosphere models, significantly reducing critical uncertainties in the predictions of these models and an improved understanding of the rate of climate change.

National Technical Means (NTM)

Various sensor systems which collectively are designed as NTM may also have applications to ocean science. Potential applications include monitoring ocean pollution, studying small scale ocean circulation structures, and assisting in field experiments. Additional details can only be provided within an appropriate classified forum.

Enabling Capabilities

There are a number of classified systems and databases which, if made available to the ocean science community, would very significantly improve its measurement and data distribution capabilities.

Precision-made navigation data from GPS has clear applicability to a host of oceanographic measurement problems. Some oceanographic applications require real-time data, while for others delayed reconstruction of navigation will suffice. Differential GPS is normally not possible in oceanographic applications. As the importance of small scale processes grows, accurate navigation is critical to a growing variety of ocean experiments. In addition, some special large scale measurements, such as acoustic thermometry, require high-accuracy navigation. In general, the required accuracy cannot be obtained from unclassified GPS data, nor ar ocean applications amenable to differential GPS as are many land applications.

Much GEOSAT altimetry mission data in the southern hemisphere have been released. Availability of the 18 months of repeat mission data over the northern hemisphere would be important to the investigation fo seasonal variability of mesoscale ocean features.

It may be that the combination of the Navy's classified GDEM (Generalized Digital Environmental Model) oceanographic model, along with its oceanographic databases, could be used to obtain an indication of past ocean warming. This issue should be explored.

Submarines are a unique dual-use asset as oceanographic measurement platforms. They can collect data from within the

ocean's volume, in contrast to aircraft and satellites which are limited to collection from the ocean's surface. In addition, they offer more continuously available measurements than can be provided by surface ships. Submarines can collect data on polar ice drafts (ice depth) and underside roughness. These data, collected over time, can be used to estimate ice thickness, a key indicator of global climate change. Small scale continuous measurements of ocean salinity, temperature, and chemical constituents can be used to improve mixing models form which ocean pollution dispersion patterns can be predicted.

Army Marine-Related Research Efforts

The Army is also actively involved in this marine-related research. Our Cold Regions Research and Engineering Laboratory has several initiatives underway which support both the global change research and marine navigation.

In conjunction with the Navy and other research institutions, the Army is conducting research on the physical, electromagnetic, and optical properties of sea ice. The work is focusing on the causes of certain remote sensing signatures from satellite observation and how these signatures evolve with time as the ice grows and decays. The goal of these studies is to make better use of satellite and airborne remote sensing technology to determine ice conditions. The emphasis is to distinguish ice types, surface conditions, and possibly ice thickness. Improved remote sensing of sea ice will greatly assist in furthering the capability to monitor the potential effects of climate change. Improved remote sensing technology will also greatly enhance deep draft navigation through ice, improve ice forecasting models, and will assist the location and monitoring of offshore structures.

Under a SERDP project the Army is analyzing a historical data set of submarine ice draft profiles to provide information valuable for climate change analyses. These data will allow a quantitative description of the ice thickness over much of the Arctic basin of which we know very little at present. These investigations are of direct application to climate change as they will produce a baseline of ice thickness and its trends for the past 35 years. The ice thickness data are especially useful for the verification of Government and private ice forecasting models. Deep draft Arctic navigation can benefit from improved ship routing derived from the thickness climatology through the identification of heavy and light ice conditions.

Many of these DoD systems show promise of improving our knowledge and understanding of the oceans and we are actively investigating the viability of these dual use applications. However,these systems and databases were developed and fielded to fulfill specific military needs and missions and they continue to do so. Both the intelligence community and DoD are currently investigating the issues associated with a broader release of environmentally relevant classified data. These reviews cover classified data collected or provided by satellites, aircraft, and

land and sea-based systems. Recommendations for release or downgrading of classified material will consider benefits to the scientific and government policy communities as well as risks to national security. At least some of the deliberations of the various reviewing organizations are expected to be completed in the fall of this year. The time and assets available that can be devoted to using these systems for environmental studies may be limited due to higher priority needs. Additionally, there are issues concerning the releasability of some of these data as well as the costs associated with making them routinely availabe to the scientific community which are currently being studied, but have not yet been resolved.

<u>Summary</u>

I'd like to close by saying these are just some of the DOD capabilities which can improve our understanding of oceans and global change. These technologies represent a new set of eyes and ears that the nonmilitary scientific community did not have before. The application of this DOD research and technology will rapidly expand the availability of ocean-related data. This work will also rapidly expand our ability to perform a more accurate analysis of our oceans and issues of global change.

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MARINE AND FISHERIES

STATEMENT OF

ROBERT S. WINOKUR

TECHNICAL DIRECTOR

OFFICE OF THE OCEANOGRAPHER OF THE NAVY

U.S. NAVY

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO

AND THE OUTER CONTINENTAL SHELF

OF THE

HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES

ON

DUAL USE OF DEFENSE TECHNOLOGY FOR

OCEANOGRAPHIC RESEARCH

4 AUGUST 1993

NOT FOR PUBLICATION UNTIL
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MARINE AND FISHERIES

BIOGRAPHICAL RESUME
ROBERT S. WINOKUR

Mr. Robert S. Winokur is the Technical Director in the Office of the Oceanographer of the Navy, Office of the Chief of Naval Operations. Mr. Winokur has served in this position since 1985 and is the senior civilian technical manager for the Navy's Operational Oceanography Program. Mr. Winokur is a career Navy employee and has over 30 year experience in Navy and national oceanography. He has served in various senior management and technical positions, including: Associate Technical Director for Ocean Science and International Programs, Office of Naval Research; Director, Planning and Assessment, Office of Naval Research; Deputy and Special Advisor, Office of the Deputy Assistant Secretary of the Navy for Antisubmarine Warfare; Special Assistant for Acoustics to the Director, Antisubmarine Warfare and Surveillance Programs, Office of the Chief of Naval Operations; and Branch Head and Division Director, Naval Oceanographic Office.

Mr. Winokur has a B.S. degree from Rensselaer Polytechnic Institute and an M.S. degree from The American University. He has published numerous papers and reports in underwater acoustics and Naval Oceanography. Mr. Winokur has received numerous awards, including the Presidential Distinguished Executive and Meritorious Rank Awards for senior executives. He is currently Vice President for Technical Affairs for the Marine Technology Society, and is a Fellow of the Acoustical Society of America.

Mr. Winokur has a broad range of experience in underwater acoustics, ocean policy, antisubmarine warfare, undersea warfare and technology, ocean ship management and construction, satellite and manned space oceanography, information technology and national environmental issues. Mr. Winokur currently is involved in activities involving the dual use of technology and the application of Navy data and systems to environmental problems.

During his Navy career, Mr. Winokur has served on numerous Navy, national and international committees in various capacities. Among these, he is or has been: the Navy representative to the national Environmental Task Force; DoD representative to the Interagency Working Group on Data Management for Global Change; U.S. representative to the NATO Scientific Committee of National Representatives; Executive Secretary, Defense Science Board Study on ASW; DoD representative to the Interagency Arctic Research Policy Study; Executive Secretary, Federal Oceanographic Fleet Coordination Council; and Chairman, Interagency Study on Ocean Bionics.

Mr. Chairman and members of the Committee, I am Robert Winokur, Technical Director, Office of the Oceanographer of the Navy. I am pleased to be here this afternoon representing the operational programs and capabilities of the U.S. Navy. I welcome the opportunity to comment on the dual use of Defense, and in particular Navy technology for civilian oceanographic research. I will be addressing specific examples of the dual use of Navy operational oceanographic technologies and data, as well as fleet operational systems and capabilities.

NAVY OCEANOGRAPHIC MISSION: The U.S. Navy has a long standing commitment to oceanography, which reflects the Navy's requirement for detailed knowledge of its operating environment. The Navy's oceanography program and resulting products and services are in direct support of Navy operational requirements. Building on operational needs, the Navy's operational oceanography program is specifically designed to collect, analyze and disseminate oceanographic data, information and tailored products to enhance the effectiveness of the fleet.

Naval oceanography depends on the development and application of new technologies, data collection systems and capabilities to provide the knowledge base and prediction capabilities required to support fleet operations. Conversely, the knowledge base derived from Naval Oceanography has also been the source of new concepts that have provided the Navy with major new fleet operational systems and advances in capabilities.

DUAL USE OF DEFENSE TECHNOLOGY: The Navy has long recognized that our infrastructure and capabilities are not just Navy assets, but are of significant value to national activities in oceanography. We believe, in fact, that we have a traditional commitment to work with the national oceanographic community to promote and ensure effective coordination, and transition of data and capabilities, where security issues are not involved and there are no mission impacts. Civil benefits from Naval Oceanography include charting, navigation, typhoon warnings, oceanographic data bases, ice forecasting, precise time, technology development, deep sea research, underwater acoustics, satellite remote sensing, and underwater vehicles.

I would like to take this opportunity to outline some of our past activities in dual use and applications, and to specifically highlight some of the efforts that have been ongoing most recently. In the interest of time, I will focus on a number of specific examples, such as: GEOSAT and GEOSAT FOLLOW-ON; declassification of data; various applications of the Integrated Undersea Surveillance System; and use of submarines for Arctic science.

Satellite Technology: The Navy GEOSAT satellite was launched in March 1985 with a primary mission, to measure the earth's shape, or geoid, with a high degree of horizontal and vertical accuracy, which was accomplished within 18 months. Because of the strategic importance of this data, it was initially classified. Subsequently, the Navy declassified all of the Geodetic Mission (GM) data acquired by GEOSAT south of 30 degrees South for release through the National Oceanic and Atmospheric Administration (NOAA). In addition, wind and wave data, which GEOSAT also measured, were released from the

classified mission for distribution by NOAA.

In September 1986 the classified mission was declared complete and the satellite was maneuvered into a new 17-day exact repeat orbit which was the same as that occupied by SEASAT in 1978. Since the altimetrically-measured sea surface shape from the SEASAT satellite was in the public domain, the GEOSAT altimetric data was not classified as long as its ground track remained within one kilometer of the SEASAT ground track. Under an agreement with the Navy, NOAA was responsible for generating the unclassified data set for the oceanographic community, where it was used for measuring the shape of the ocean surface.

The GEOSAT altimetry data has now been used extensively by the research community to study major oceanic mesoscale features such as the Gulf Stream and associated eddies or rings, to study gravity fields and bottom topography in the Southern Hemisphere, and to support studies in ocean modeling for global climate change. Similarly, the Navy used GEOSAT data to better describe those oceanographic features that impact on submarine detection, and to provide essential data for our global ocean forecasting models.

A GEOSAT FOLLOW-ON (GFO) mission is planned for mid FY-96. Building on the success of GEOSAT, the GFO will be in the same 17-day exact repeat orbit as GEOSAT. The altimeter data will be processed at the Naval Oceanographic Office's Altimetry Data Fusion Center and all environmental data records (EDR) disseminated to NOAA's National Environmental Data and Information Service (NESDIS) for distribution to the civilian community. In

addition, perishable wave data will be transmitted to the Fleet Numerical Oceanography Center (and the collocated NOAA Ocean Applications Group) in Monterey CA to generate operational oceanographic products for end users. Ice index data will be transmitted to Suitland MD, where the Navy's Polar Oceanography Center (and the collocated NAVY-NOAA Joint Ice Center) will prepare ice analyses and forecasts.

Declassification of Data: The U.S. Navy makes approximately 150 expendable bathythermograph (XBT) observations per day for operational use. These reports contain temperature profiles and the location (time/date) where the observations were made by fleet units. The observations are important for predicting sound propagation in the sea and, therefore, for sonar performance predictions for submarine detection.

The observations are also important for a number of civilian applications including ocean and global climate change modelling. The U.S. Navy declassifies most of these data after 30 days, thereby contributing approximately 55,000 observations per year to the public domain data base. These data are sent to NOAA's National Oceanographic Data Center for archiving and unrestricted distribution.

The Navy has developed a digital model for characterizing different water masses and temperature profiles within the ocean. This model, known as the Generalized Digital Environmental Model (GDEM), is currently restricted from public distribution. However, since the model may have applications to ocean climate studies, we are reviewing its selected release. The Navy also maintains a Master Oceanographic Observation Data Set (MOODS) consisting

of over 3.5 million unclassified observations. New unclassified data is regularly provided to NOAA's National Oceanographic Data Center (NODC) for public distribution.

Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager (SSM/I): The first DMSP SSM/I sensor was launched in June 1987. The instrument measures cloud water content; rain rates; water vapor over the ocean; marine wind speed; sea ice location, age and concentration; snow water content; and land surface type, moisture and temperature. A total of seven SSM/I's are scheduled to be launched through the next decade. SSM/I data and derived products are unclassified and made available to the civilian community in near real-time through NOAA.

Submersibles: The Navy has made available its Deep Submergence Vehicles (DSV) Turtle and Seacliff and its nuclear submarine NR-1 for civilian oceanographic and deep sea research. Use of these vehicles is coordinated through the National Undersea Research Program of NOAA and with the University National Oceanographic Laboratory System (UNOLS). Approximately 60 days of civilian use is available each year, and perhaps as many as 120 days per year could be provided if additional funds for civilian use were made available to the civilian research community.

In addition, partnerships have been developed with several non-profit organizations for educational and deep sea exploration. For example, the Navy's deep submergence assets were used in conjunction with the National Geographic Society to explore for ships sunk during the Battle of Guadalcanal, and with the JASON Foundation for Education in March 1993 as deep sea

operations were broadcast live to 500,000 students in the U.S., Canada and Great Britain. These assets were also used in the Challenger recovery operations.

CURRENT DUAL USE PILOT PROGRAMS

Integrated Undersea Surveillance System (IUSS): During the Cold War, the Navy made antisubmarine warfare a mission of the highest priority to counter the threat posed by the Soviet submarine fleet. As a consequence, the Navy developed a variety of acoustic systems to detect and track submarines. One of the most expansive of these ASW systems is the Integrated Undersea Surveillance System, which is comprised of fixed and towed acoustic arrays that have been used for several decades to detect and track submarines and surface ships across wide expanses of ocean.

One component of IUSS involves the use of fixed, bottom mounted arrays of hydrophones cabled to shore, which are collectively known as the Sound Surveillance System (SOSUS). In order to provide a flexible, forward deployed surveillance capability, a mobile system called the Surveillance Towed Array SONAR System (SURTASS) was developed and a number of ships constructed specifically for towing the SURTASS arrays. A third component which was developed to detect the increasingly quieter Soviet submarine threat was a long-range, low-frequency active system capable of transmitting high powered acoustic signals and detecting echoes over very long distances. Communications and sophisticated signal processing tied these systems together into the cohesive network known as the Integrated Undersea Surveillance System (IUSS). IUSS grew to over 30,000 miles of cable, a score

of ships, and tracking stations around the world.

The Navy's undersea surveillance system IUSS, is a highly capable military system that provides an unmatched acoustic observatory into the ocean for both Navy and civilian applications. IUSS has the potential to contribute to nationally important scientific and civil applications, as well as to develop advanced acoustic remote sensing means to better understand the dynamics and three dimensional temperature structure of the ocean. Recognizing that potential, the Navy has sponsored various R&D projects that utilize IUSS system components.

One of the earliest applications of IUSS came over a decade ago, when the Navy co-sponsored research with the National Science Foundation to develop acoustic techniques as a means of observing changes in ocean temperature over basin scales. This technique, called acoustic tomography, provided the Navy with a new means of understanding ocean circulation and temperature changes for use in acoustic studies.

In addition to IUSS receivers which were used for acoustic tomography experiments, we also made available our large, high-powered acoustic sources to the civilian community for the conduct of the Heard Island Experiment. This experiment demonstrated clearly the capability to monitor sound transmission over thousands of miles for the purpose of assessing the feasibility of using acoustic transmission paths to measure long-term temperature changes in the ocean, and hence possible climate changes. As a consequence of the capabilities provided by the Navy from IUSS and Navy sponsored research, a major new project referred to as Acoustic Thermometry of the Ocean (ATOC)

has been established and is underway through the Strategic Environmental Research and Development Program (SERDP).

Dual use of the Integrated Undersea Surveillance System provides similar opportunities for the civilian community in a number of important scientific and environmental applications, and we have been working with NOAA specifically to demonstrate capabilities in marine mammal monitoring, marine seismology, and fisheries law enforcement.

Whales '93: Since whales vocalize loudly and frequently, IUSS receivers can detect whales every day on practically every acoustic beam in the system; however, since these sounds are interfering noise sources when looking for submarines it was necessary to remove them by signal processing. By treating whale sounds as the signal, it is possible for the first time to develop a real-time, basin-wide synoptic view of whale locations and tracks from shore without disturbing the whales.

Whales '93 is a six month test begun in November 1992 to utilize IUSS to monitor and track several species of whales in the Western North Atlantic. In the first three and a half months of Whales '93 a phenomenal number of discoveries have been made about deep water whales. According to the civilian scientists involved, more detections of blue, finback, and minke whales have been made than are contained in data bases for all previous coastal whale studies. Already, more new sound types have been recorded and patterns of vocalization documented than there are in all past scientific literature combined. The world's knowledge of whales is being redefined.

<u>Marine Seismology</u>: A significant proportion of the heat transferred from the earth's interior to the ocean/atmosphere system is thought to occur through volcanic activity on the deep sea floor along the mid-ocean ridges. Currently there is very little understanding of the extent, duration and nature of such activity, or the significance of sea floor volcanism in perturbing the global environment.

The first demonstration that Navy IUSS arrays could alert geophysicists to volcanic activity on the mid-ocean ridge occurred on June 26, 1993. Scientists working under the NOAA VENTS Program utilized acoustic data from several remotely located IUSS surveillance arrays in the Pacific to identify an earthquake swarm (about 30 per hour) on a supposedly inactive segment of the Juan de Fuca Ridge. Using the signals detected on the IUSS receivers to localize the site, two research vessels subsequently discovered a "megaplume" of heated water and a seven-kilometer stretch of fresh lava along the ridge. This example is directly analogous to the traditional ASW role of IUSS for detection, localization and cuing. In addition, the monitoring of acoustic phases of mid-ocean earthquakes (i.e. "T-Phases") permits the detection of much smaller earthquakes than can be detected using the land-based geophysical detection network.

<u>Fisheries Enforcement</u>: By using the sophisticated capabilities of IUSS to detect and classify signals in the ocean, it was suggested that the system could possibly be used to detect and classify fishing vessels which are violating laws and regulations, such as the Driftnet Fisheries Enforcement Act. With limited resources available for enforcement, finding violators can be a very difficult

problem. In collaboration with the National Marine Fisheries Service and the Coast Guard a brief experiment was conducted in the Pacific Ocean in September 1992 to assess the feasibility of using IUSS in this role and to determine signal processing requirements. This experiment offered an opportunity to monitor over 30 driftnet fishing vessels, direct maritime aircraft to the derived locations and to share information with the National Marine Fisheries Service. The results of the Pacific Driftnet Experiment indicate that IUSS can be extended to detect, track and localize fishing vessels.

In yet another possible use, IUSS could contribute towards fisheries assessments by monitoring fishing vessel activity, natural "predators" such as sperm whales and orca, and the aggregate noise spectra associated with fish and crustaceans. Merging of existing techniques with IUSS capabilities could result in more thoroughly, efficiently, and accurately determined fishing stock assessments.

It is important to note that Navy has undertaken these cooperative efforts by making special security arrangements and on a strictly not-to-interfere basis. We have cleared scientists and provided them with access to selected elements of IUSS in accordance with strict security guidelines. While we have been supportive of investigating the dual use of this unique military asset, I must emphasize, as you know, that our mission objectives are satisfied first. Finally, as a consequence of fiscal constraints and the necessity to downsize, the Navy has provided three (T-AGOS) ships which were used for SURTASS operations from IUSS assets to NOAA for conversion to civilian use.

It is fairly obvious that IUSS capabilities are a focal point for dual use

and the various activities being pursued indicate, rightfully so, the great potential of this resource. For sake of clarification, I would like to point out that IUSS is an operational system with resource sponsorship coming under the direction of the Undersea Surveillance Branch in the Office of the Chief of Naval Operations and program management under the direction of the Undersea Surveillance Program Directorate in the Naval Space and Warfare Systems Command. Support for various demonstration projects has been provided by the program sponsor and office, the Strategic Environmental R&D Program, the Office of Naval Research and the Naval Research Laboratory. In short, this is a success story that everyone wants to be a part of and share in the credit.

SUBMARINE ARCTIC SCIENCE CRUISE-93: The U.S. Navy will conduct the first undersea Arctic science cruise for the U.S. science community at the end of this month. Five civilian scientists will get underway with the USS Pargo (SSN 650) for 19 days. Forty-five experiments in the areas of global climate change, geological evolution of the Arctic Ocean basins, movement and changes of the permanent ice pack, and the Arctic Ocean's biological and chemical environment are planned. This exercise, known as Submarine Arctic Science Cruise-93, is the first U.S. nuclear submarine cruise totally dedicated to Arctic science exploration and is a unique cooperation between the U.S. Navy and the U.S. science community.

In addition to selected Navy interests in the Arctic, we recognize the importance of Arctic science research to national programs. Since the Arctic Science Cruise-93 is primarily a non-military venture, the Navy does not have similar projects planned or funded. The Navy is willing to actively pursue

making further platforms available for research in the Arctic, but the Navy is unable to immediately commit to future projects without the consideration of additional funds. Cost estimates are approximately $20,000 per day for submarine operations in addition to the cost of the experiments. If we are to continue to conduct detailed scientific research in the Arctic, then we should commit ourselves to the use of U.S. submarines and fund appropriately.

MECHANISMS: Interagency committees and cooperative agreements are the primary mechanisms in place which facilitate the dual use of Defense technology.

The U.S. Global Change Research Program (USGCRP) is a cooperative effort among the Federal agencies to help develop sound national and international policies related to global environmental issues, particularly global change. The Navy participates in the USGCRP through five focused programs: ocean measurements, high latitude dynamics, regional resolving models, boundary layer dynamics, and ocean ecological dynamics. The Global Change Data and Information System (GCDIS) is a coordinated effort of federal agencies to facilitate access to global change data. The Navy routinely collects environmental data globally in support of Navy operations and conducts mission related research into environmental processes and conditions that affect Defense operations, tactics, and systems. Whenever possible, Navy data products are made available to the appropriate U.S. national archives for inclusion in the GCDIS. Those archives include NOAA's National Climatic Data Center, National Geophysical Data Center, and the National Oceanographic Data Center.

The Office of the Federal Coordinator for Meteorological Services and Supporting Research's (OFCM) Committee for Operational Processing Centers (COPC) consists of the directors and commanders of the NOAA National Meteorological Center (NMC), Fleet Numerical Oceanography Center (FNOC), Naval Oceanographic Office (NAVOCEANO), and Air Force Global Weather Center (AFGWC). The COPC meets biannually to share information on a wide range of subjects ranging from environmental models to high speed communication. As a result of COPC activity, the FNOC and NMC serve as mutual backup in case of prolonged computer outages. Plans are considered and developed to establish efficient exchange of data and products required for their respective operations and applied research as well as the consolidation of services to reduce duplication of effort.

The Federal Geographic Data Committee (FGDC) promotes the coordinated development, use sharing, and dissemination of geographic data. The committee oversees and provides policy guidance for agency efforts to coordinate geographic data activities. Navy participates with the Defense Mapping Agency (DMA) on the FGDC's Subcommittee for Bathymetry. The Subcommittee establishes protocols and implements standards for data content, quality, and transfer; encourages the exchange of information and the transfer of data; and organizes the collection of geographic data to reduce duplication of effort.

The Defense Hydrographic Initiative (DHI) provides formal coordination among the DMA, Office of the Oceanographer of the Navy, and NOAA regarding the collection, processing, archiving, analysis, integration, production,

and distribution of hydrographic and bathymetric data; and transition to support of digital products to the user community. The DoD and civil maritime communities require hydrographic and bathymetric data of ever increasing accuracy and coverage. The availability of precise satellite and navigation systems developed from Defense technology highlight the expanding demand for these data.

At the Navy-NOAA Joint Ice Center the dual use of Defense satellites, aircraft, and computer systems to produce global sea ice analyses for distribution to government, military, university, research, private industry and foreign users. The 22-year continuous sea-ice data base represents an important data set used by many of the world's leading global climate change scientists.

SUMMARY: Mr. Chairman, in summary I appreciate the opportunity to address the Committee today. In my testimony, I have outlined some of our past activities and long-standing commitment to work with the civilian oceanographic community. During the past few years, we have pursued new and exciting opportunities with the civilian oceanographic research community in the dual use of unique Navy technology and assets insofar as mission and security considerations permit. I believe the results of these collaborative efforts should be viewed as outstanding successes that provide new capabilities leading to a better understanding of various oceanic processes and marine mammal behavior.

This concludes my prepared statement. I will be happy to answer any questions you may have at this time.

Questions for August 4, 1993 hearing on
Dual Use of Technology and Resources for Civilian and Defense
Oceanography

Mr. Winokur:

1. Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?

2. In terms of ocean models and data, what are the security concerns? Why are certain data not released or released after a waiting period?

3. You say that Naval submersibles may be available to the civilian community for as many as 120 days per year. Is this due to a reduction of Navy usage? How many days per year are the subs used by the Navy? Where would the funds for civilian use come from?

4. You refer to operational oceanographic products generated by GEOSAT data. What are these products and who are the users?

5. Using the IUSS system can you actually differentiate fishing vessels using driftnets and those using legal methods?

-- Are there other marine species that the IUSS can be used to detect?

-- Can the system be used to detect foreign vessels fishing illegally in U.S. waters?

6. In the testimony, you speak of the need to make a commitment to the use of submarines to study the Arctic Ocean. Is the Navy prepared to make this kind of commitment? How would you expect this cooperation to be funded?

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SUBCOMMITTEE ON OCEANOGRAPHY,
GULF OF MEXICO AND THE OUTER CONTINENTAL SHELF
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AUGUST 4, 1993
QUESTIONS FOR THE RECORD TO MR. ROBERT W. WINOKUR

Question 1. Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?
Answer: Navy data sets and technologies are utilized to generate atmospheric and oceanographic products for which a number of commercial uses have been developed. Among the products are analyses of ocean surface temperature, wind speed, wave height, sea state, surface currents, oceanographic fronts and eddies, and sea ice coverage.

Commercial uses of these products include ocean routing forecasts to maritime ship operators, oceanographic and weather forecasts for commercial fishing and off-shore petroleum operations/exploration activities.

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Question 2. In terms of ocean models and data, what are the security concerns? Why are certain data not released or released after a waiting period?
Answer: In general, our security concerns are directed toward not releasing to the public domain, Navy developed oceanographic models which could be acquired by a potential adversary for use in military actions against us or our allies. The models of concern are those designed for military applications, such as understanding the limits imposed by the environment on sonar detection, oceanographic factors limiting weapons systems performance, and improving prediction and analytical models that help weapons system designers and operators understand system performance. There is no intention to classify the physics--rather only the applications to weapons systems and capabilities, e.g. mine drift/burial. Likewise, high resolution, geographic and system related data collected for ASW acoustic parameters, ballistic missile submarine (SSBN) operations, and weapons are classified.

There are certain data sets which have not been released and do not have a declassification date. These include data which indicate regions of high operational interest, e.g. tracks revealing certain operational intent or locations of specific interest, and data accepted from foreign navies on the basis of restricted distribution.

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Question 3. You state that Naval submersibles may be available to the civilian community for as many as 120 days per year. Is this due to a reduction of Navy usage? How many days per year are the subs used by the Navy? Where would the funds for civilian use come from?

Answer: The Navy initiative to expand access to Navy submersibles was focused primarily on the Deep Submergence Vehicles DSV SEA CLIFF and TURTLE. The 60 days of support of oceanographic research was based on a number of factors such as support vessel availability, maintenance schedules, and Navy requirements for deep ocean search, inspection, and recovery. Since this policy was adopted, the Navy has acquired several Remotely Operated Vehicles (ROVs) which now perform some of the undersea search and recovery work previously done exclusively by the DSVs, permitting them to be used more for oceanographic research. In addition, Submarine NR-1 is available for use by the civilian academic community. For all submersibles and ROVs, the Navy can accommodate 120 days for civilian research.

Support for civilian use is outside the Navy mission and no funds are available, especially today with a severely reduced Navy budget. Navy is willing to operate the vehicles, but funding must be provided. Funds for these civilian projects are normally provided by the users. The current arrangement is for NOAA's National Undersea Research Program (NURP) to pay for the submersible time to support civilian researchers. NURP's present budget is insufficient to support 120 days of Navy submersible time. Augmentation of NURP's budget would enhance this cooperative program with NOAA. The participation with NURP by other civil agencies with undersea research interests could provide an additional funding source for civilian use of Navy submersibles.

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Question 4. You refer to operational oceanographic products generated by GEOSAT data. What are these products and who are the users?

Answer: The GEOSAT FOLLOW-ON (GFO) is planned for mid FY-96. The GFO data will be processed by a highly automated product-generation and dissemination system enhanced by a rapid response, man-machine quality control program. GFO data will be an input into ocean prediction models, which in turn are tailored for specific Navy use in ASW, mine warfare, etc. Sophisticated computer models will generate application specific and generalized atmospheric, oceanographic, and acoustic products designed for the needs of Navy weapons, sensors, and platforms. The operational products which will employ the GEOSAT data include analyses of ocean surface wind speed, wave height, sea state, surface currents, oceanographic fronts and eddies, ice edge location and ocean prediction models for thermal structure and acoustics.

The end use for operational oceanographic products is the support of all Navy aircraft, surface ship and submarine operations. For example, the products are also used in locating fronts and eddies which are of importance to ASW and other operations and for the Navy's Optimum Track Ship Routing (OTSR) system, which is utilized to recommend routes to ships to avoid hazardous weather conditions while saving time and/or fuel.

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Question 5: Using the IUSS system can you actually differentiate fishing vessels using driftnets and those using legal methods?
-- Are there other marine species that the IUSS can be used to detect?
-- Can the system be used to detect foreign vessels fishing illegally in U.S. waters?
Answer: We do not believe that the use of IUSS alone can reliably differentiate between fishing vessels using dirftnets and those using legal methods. The use of IUSS to detect vessels using driftnets based upon the patterns that are unique to driftnetting has been demonstrated in a brief experiment. Searching and differentiating between the fishing vessel patterns is like searching and differentiating between needles in a hay stack. Detecting driftnets is accomplished more easily when there is some advance knowledge in which sector a vessel using illegal methods may be operating.

IUSS should be capable of detecting other marine species which emit sounds within the low frequency range of the system. The capabilities of IUSS are limited due to the physical location of the arrays.

The IUSS was designed to detect submarines outside of U.S. waters and no design consideration was given to using the IUSS for detecting vessels within the U.S. Exclusive Economic Zone (EEZ). We do not know if detecting fishing vessels or discriminating between U.S. and foreign fishing vessels is possible. However, we believe the detection of vessels fishing illegally in U.S. waters may be possible, particularly by using the IUSS in conjunction with other targeting systems. Additional research and development is required.

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Question 6. In the testimony, you speak of the need to make a commitment to the use of submarines to study the Arctic Ocean. Is the Navy prepared to make this kind of commitment? How would you expect this cooperation to be funded?

Answer: The Navy is prepared to make further submarine platforms available for civilian research in the Arctic, but the Navy is unable to immediately commit to future undersea Arctic science cruises without the consideration of additional funds.

Such a project is an ideal candidate to demonstrate the dual use of defense assets to study the Arctic Ocean under the ice, i.e. putting them to the service of the civilian science community for global climate change research; however, funding for the project should be provided without negatively affecting the Navy's budget and within the context of civilian science's interests and budgets. For example, funding for the cooperative project could come through the Advanced Research Projects Agency's (ARPA) Technology Reinvestment Project, the Strategic Environmental Research and Development Program (SERDP), the U.S. Arctic Research Plan, or the Environmental Task Force.

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STATEMENT OF

DR. ERIC O. HARTWIG

ASSOCIATE DIRECTOR

OCEAN AND ATMOSPHERIC SCIENCE AND TECHNOLOGY

NAVAL RESEARCH LABORATORY

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO

AND THE OUTER CONTINENTAL SHELF

OF THE

HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES

ON

COOPERATION AND DUAL USE OF DEFENSE TECHNOLOGY FOR

OCEANOGRAPHIC RESEARCH

4 AUGUST 1993

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Mr. Chairman, distinguished members of the Oceanography, Gulf of Mexico, and the Outer Continental Shelf Subcommittee, I appreciate the opportunity to provide, on behalf of the Chief of Naval Research, opportunities for cooperation and dual use between the Navy's science and technology (S&T) community and other federal agencies and the civilian community.

I will provide testimony on the Navy's Science and Technology (S&T) work which is all under the Chief of Naval Research (CNR). The CNR has two major components: (1) extramural S&T is sponsored by the Office of Naval Research (ONR); and (2) intramural S&T is conducted by the Naval Research Laboratory (NRL).

The CNR organization is a manager and executor of oceanographic and maritime atmospheric S&T. Most of these efforts are documented in the archival literature, technical reports, patents, and various technical society symposia. In fact ONR and NRL have a long history of not only being at the forefront of Naval relevant ocean environmental S&T, but also of doing cooperative research with NSF, NASA, NOAA, DOE, USGS and other federal agencies and the civilian community, especially academia.

The technologies I will discuss below were developed in direct support of Navy operations, systems acquisition, and the protection of naval personnel and their ships, aircraft, submarines and other platforms. It is the ocean environment that makes a navy a navy. This leads to the Navy having a vested, and significant involvement in ocean environmental S&T.

Given the wide spectrum of Navy operations and the need for rapid incorporation of new technology sustaining our technological superiority, it is an appropriate requirement for the CNR's ocean and atmosphere S&T effort to be broad scientifically. Dependent on the application, it may be directly coupled with the operational Navy (in many cases it is a system-specific classified coupling), or it may be coupled with the S&T work underway in academia and/or other federal agencies. This approach ensures that the Navy's operational capability can benefit from advances developed in the entire community: extramural and intramural, classified and unclassified.

There are many potential Navy- and DoD-developed technologies to consider for dual use and cooperative development with other federal agencies and the civilian community. As there is no clear separation between the application of these technologies to either the civilian uses or programs managed by other federal agencies, I have lumped them together.

In considering civilian applications for Navy-developed oceanographic technologies, it must be recognized that none of these examples are turn-key operations. One can't just come in, sit down, and necessarily be provided the information one wants. If there is a DoD technology that is potentially suitable for use by other federal agencies, an additional R&D investment will still generally be required to make it useful to their needs. However, even with this investment, the non-DoD users can still realize a significant cost savings, since the most expensive part of the R&D investment has already been made.

One way to think of transitioning DoD technology to civilian use is to consider it as similar to patent licensing. Generally, a company requests a licensing agreement with the patent holder. Once access to the technology has been obtained, the company invests additional R&D funds to modify it to meet the needs of the company. Through this transition investment, the company obtains the benefit of the technology without having to fund its original development, and all sides come out ahead. The same model applies in transitioning DoD developed technology to civilian uses.

NAVY OCEAN AND MARITIME ATMOSPHERE S&T CHALLENGE

The Navy oceanographic community is currently confronting a truly grand challenge - to obtain an oceanographic and maritime atmospheric prediction capability that will work at all time and space scales. To do this, we must be able to observe and understand how the ocean and marine atmosphere systems interact and evolve in both time and space.

The Navy has a requirement to provide timely and continuous operational forecasts of the oceanic and atmospheric conditions to the fleet. The foremost operational prediction facilities in the U.S. are located at the Fleet Numerical Oceanography Center (FNOC) in Monterey California and at the Naval Oceanographic Office (NAVOCEANO) at the Stennis Space Center, Mississippi. Both of these facilities are field activities of the

Oceanographer of the Navy, represented by Mr. Winokur here today. Not coincidentally, major oceanographic and meteorological research components of NRL are co-located with these two operational analysis and forecast centers.

To meet requirements, the Navy operational and S&T oceanographic communities have developed and put in place the capabilities to collect, transmit, and manage global ocean and atmospheric data sets and assimilate these data into operational forecast models of the ocean and maritime atmosphere. The S&T work which supports this global capability is at the leading edge both nationally and internationally, and the technology and techniques being developed are continually being improved to enable the Navy to operate in its environment more efficiently, more safely, and smarter.

S&T ASSETS

Specific examples of Navy S&T assets which can be made available for cooperative efforts are: research vessels; the ALVIN submersible; research aircraft; acoustic, optic and radar remote sensors and measurement systems; specialized and advanced laboratory capabilities; high performance computers, advanced networking, and data manipulation technologies supporting ocean modeling and simulation; a variety of at-sea equipment; fiscal resources; and, most importantly, experienced and expert scientists, engineers, S&T managers and technicians.

MECHANISMS

The Congress and Executive Branch have made available several mechanisms to conduct cooperative oceanographic programs and encourage the civilian use of DoD-developed oceanographic technologies. No single mechanism or approach is best, and organizations must use the appropriate ones, within their organizational policy constraints and the law, to do the job.

Mechanisms available include but are not limited to: patents and licenses; Cooperative Research and Development Agreements (CRDAs); grants and contracts; publications and reports; Small Business Innovation Research Program (SBIR); the Federal Coordinating Committee for Science, Engineering and Technology (FCCSET) and its subcommittees; the Federal

Fleet Coordinating Committee; the Intergovernmental Personnel Act (IPA) which provides a means for the exchange of scientists and engineers among federal agencies and with non-federal organizations; the Strategic Environmental Research and Development Program (SERDP); the Environmental Task Force (ETF); the existing relationship under which the Oceanographer of the Navy serves as the Navy Deputy to the Administrator to NOAA; and a recent MOU between NSF and ONR to cooperate in S&T.

Truly cooperative programs are based on partnerships in which all partners gain from the effort. In most cases this gain is through mutual leverage of the investments made by the partners. This is particularly true in mounting at-sea experiments. Major at-sea field programs are incredibly expensive, and often no single organization has all the required talent, platform access, funding or data reduction and analysis capability to ensure a successful experiment. Our best cooperative efforts come from rigorous, joint planning with plenty of lead time, followed by execution in carefully scheduled, discrete segments over the life of the project. This allows the cooperating groups to bring all their requirements and assets to the table, develop the best plan "at the time" and then allow for change as experience is gained or circumstances change.

COOPERATIVE DUAL USE OPPORTUNITIES

The challenge to predict ocean behavior provides significant opportunities for cooperative dual use efforts. I believe the most significant of these are in three interrelated areas:

- Remote sensing from space, air and in the water;
- Ocean and marine atmospheric modeling, and
- Environmental quality.

EXAMPLES OF OPPORTUNITIES

REMOTE SENSING

A significant Navy S&T capability is remote sensing from aircraft and space, integrated with in-water-based sensors. The Navy S&T community has developed, put in place, and used active and passive acoustical, optical and radar remote sensors to measure a variety of parameters in a variety of ways to many different time and space

resolutions. Remote sensing technology provides DoD with a number of unique capabilities required to support a broad spectrum of warfighting missions.

Navy-sponsored remote sensing is conducted in cooperation and in conjunction with civilian agencies (NASA, NOAA and DOE). For example:

- NRL's and ONR's efforts in ice remote sensing and forecasting provides enhanced capability to the Navy/NOAA ice forecast center located nearby in Suitland, Maryland.

- There is presently a major interagency/academia/industry effort called the Environmental Task Force, initiated by then-Senator Gore and then-CIA Director Gates, through which NRL scientists are helping to examine the suitability of using historically classified assets and data to provide environmental information that may be of use to other federal agencies and the civilian community.

IN WATER BASED REMOTE SENSING

IUSS/SOSUS System

A prime example of and opportunity for potential dual use opportunities involves the use of the IUSS (Integrated Undersea Surveillance System) and its SOSUS (Sound Surveillance System) array assets to collect acoustic signals of interest to civilian scientists. CNN and other news sources recently reported on NRL's effort to ease access to these data by the civilian scientific community. The SOSUS assets are funded by the Space and Naval Warfare Systems Command (SPAWAR) and the Navy Fleet Commanders and operated by operational Navy units. During the Cold War era the data were closely held as they were of fundamental importance to strategic deterrence. With the decline in the strategic threat, the Navy, realizing the potential uses of the data, has taken a number of actions to make it available, under certain security restrictions to civilian researchers. In response to this opportunity, a facility was built at NRL to provide non-DoD users access to many IUSS data.

Results from this opportunity were recently presented at a news conference. Dr. Chris Clark from Cornell University, who is participating with NRL in this effort, believes access to this technology has

revolutionized marine mammal research. He said "in the first six weeks of the project, more total whale detections were recorded than exist in data bases collected by scientists in the last 20 years".

Dr. Clyde Nishimura of NRL documented the capability of the arrays to detect and localize ocean seismic events, a capability that the interagency Global Change "RIDGE" community is interested in obtaining in order to understand the formation and deformation of the earth's crust. Through access to SOSUS data, Dr. Nishimura was able to detect hundreds of seismic events per month along the Northern Mid-Atlantic Ridge, compared with less than 10 per month detected using land-based sensors.

This same system has other, still undemonstrated, potential uses to assist non-DoD agencies and the civilian community. These uses include: as a component of the planned Global Ocean Observing System; as a real-time acoustic data link to receive data from subsurface drifting buoys and other subsurface ocean sensors which cannot transmit via satellite; detection and localization of atmospheric storm activity over the ocean; as an integral remote sensor for experiments such as the Navy-initiated Heard Island experiment on global warming; its successor sponsored by ARPA called ATOC (Acoustic Thermometry of the Ocean); and a potential SERDP sponsored marine mammal monitoring effort.

The IUSS assets and capabilities are clearly of benefit to many agencies, in addition to their fundamental importance to national security.

MAPPING, CHARTING AND GEODESY

Accurate mapping, charting and geodesy (MC&G) information is a clear DoD requirement. While the Defense Mapping Agency (DMA) acts as the central point for preparing and distributing the products needed by DoD, Navy surveys collect much of the data, and NRL is specifically chartered to provide the required research and development in support of this survey effort. This mission requires a broad set of capabilities to advance the state-of-the-art in ocean bottom mapping, characterizing its variability, and analyzing its engineering properties at all ocean depths. Navy researchers make their information available to other agencies with MC&G missions and we are eager to capitalize on their successes as well.

The technology being developed also has broad application to industry requirements to map geophysical properties of the sediment for pipeline routing and detection/localization. In addition, some components of this technology have broader applicability than just mapping the ocean bottom. For example, the visualization technology for map and chart data as seen from a continuously moving platform is already in use in Navy aircraft, enabling pilots to continuously know exactly where they are. NRL is currently discussing this technology with the Department of Transportation to determine its applicability to some of their requirements.

ACOUSTIC SEAFLOOR CLASSIFICATION SYSTEM

The CNR has worked to develop acoustic systems which sample the ocean bottom and subbottom to improve our understanding of the geological processes responsible for the observed structure and physical properties. These properties are of fundamental importance to such Navy missions as mine warfare and mine counter measures (MIW, MCM), shore side facilities construction, and anti-submarine warfare (ASW).

One particular system with potential civilian use for mapping and charting applications is NRL's Acoustic Seafloor Classification System (ASCS). The ASCS is normally operated at 15 kHz, and both quantitatively and qualitatively measures the amplitude (echo strength) and pulse character of the returned acoustic signal in 10 adjustable width-time windows that correspond to depth increments in the sediment. Using appropriate signal processing of the returned signal and the use of known empirical relationships, the ASCS produces a continuous profile of predicted sediment structure and type, as well as various geotechnical properties of the sediment, such as attenuation, density, porosity, shear strength, compressional and shear velocity, and mean grain size.

Another system is the ONR-sponsored chirp sonar which is a towed, digital, frequency-modulated (FM), subbottom profiler that produces high resolution images of ocean sediments. The system transmits computer-generated FM pulses that sweep over an area. The FM signal can cover a range of frequencies from 200 Hz to 30 kHz and resolve sediment layers as close as 5 cm apart. This technology has been transitioned to U.S. industry which is marketing it in the U.S., Japan and Europe.

These systems provide a capability to address several important issues of value to the U.S. Navy in shallow water areas. They also can be used to address numerous issues of importance to the private sector. An example of such an issue is to rapidly assess the potential of areas, such as the Chesapeake Bay, to grow oyster beds on artificial reefs. Successful oyster growth is generally endemic to shallow, coastal/estuarine areas. Of particular importance in this case is the establishment of appropriate hard-surface growth substrata for the young oyster. The classification technologies developed by ONR and NRL could potentially identify areas which have subbottom structures with adequate bearing strength to support the development of artificial reefs (e.g. old automobile tires). These reefs, once established, can be seeded and developed into productive oyster-bearing beds.

DEEP-TOWED MAPPING SYSTEMS

Several Deep Towed Mapping Systems (DTMS) systems have been developed capable of providing very high-resolution, optical and/or acoustic profiles of the ocean bottom and subbottom structure. The NRL-developed Deep Towed Acoustics/Geophysical System (DTAGS) derives its high-resolution potential by placing both the acoustic projector and its multi-hydrophone linear array receiver near the bottom. This geometry makes it possible to obtain detailed characterizations of the structure of the sediments, compressional velocities within the sediments, and acoustic bottom loss as a function of acoustic grazing angle and frequency. This knowledge is useful in ASW, MCM and MIW.

DTMS have been used to define significant areas of clathrates (frozen methane gas) in these surficial sediments. The presence of these apparently extensive gas pockets may have a significant impact on future energy availability issues and air and water pollution concerns. Cooperative research discussions on clathrates have occurred with DOE.

DTMS also offer significant potential for NOAA and USGS with regard to requirements for mapping the Economic Exclusion Zones of the continental United States and, cooperatively, the EEZ's of other countries.

SWATH SUBBOTTOM SYSTEM

NRL is presently developing a unique Swath Subbottom System (SSS). The SSS will have a capability to provide low- and high-frequency (LF from 500 to 2000Hz and HF at 11.5kHz) backscatter from the seafloor interface and the upper 50-100 meters of the seafloor sediments. This system is unique in that the parametric techniques used produce equivalent beamwidths at both HF and LF, and provides simultaneous information on bottom morphology and subbottom heterogeneities.

Because of its swathmapping capabilities, the SSS is useful not only for Navy ASW and navigation applications, but also offers significant potential for providing subbottom "maps" of offshore areas of interest to the petroleum industry, and for mapping and exploitation of the EEZ.

AIRCRAFT BASED REMOTE SENSING

HYPERSPECTRAL CHARACTERIZATION

ONR and NRL are developing algorithms, tools and methodology to extract coastal optical parameters and variability of bottom properties (spectral reflectivities, bottom types and mixtures) using very high spectral resolution (hyperspectral) passive remote sensing optical data. This data is useful in amphibious warfare (AMW), surveillance and other operations. The major optical properties are divided into (1) water properties (attenuation coefficient, chlorophyll concentrations, suspended sediments) and (2) bottom properties (spectral reflectivities, bottom types and mixtures). The Navy emphasis is on the bottom properties. Such optical parameters are needed to assess MCM sensor effectiveness during mine clearance/avoidance operations in coastal areas.

Presently techniques are being developed to exploit satellite and aircraft multispectral digital imagery for naval applications. In particular, specialized image-processing computer algorithms to extract water depth information from multispectral imagery have been developed. Other image processing procedures and techniques of image enhancements, warping to standard map projections, and land classification have also been investigated. A number of specialized statistical techniques have also been developed to enhance the imagery to allow the detection and location of small, shallow objects (hazards to navigation).

The hyperspectral geophysical algorithms have potential applications to many non-Navy users. Current participants in the hyperspectral dual use development include Navy, NOAA, USGS, DOE, Army and NASA. Civilian applications and users of hyperspectral optical remote sensing data abound. These include many of the participants in the Defense Hydrographic Initiative (NOAA, USGS). In addition, all of these techniques developed to characterize the seafloor could be applied to commercial exploitation of the near shore region (fishing management, minerals, pollution monitoring, navigation, recreation) as well as support EEZ commercial developments.

LIDAR

LIDAR (light detection and ranging) is an active optical remote-sensing technology with a wide range of Navy applications. Navy S&T efforts are enabling the Navy to measure atmospheric and oceanographic optical properties that are critical to weapon sensor performance, and enable the remote mapping of shallow coastal regions of the world. These S&T efforts will potentially make LIDAR technology useful to other agencies (NOAA, USGS, EPA) and the civilian sector for measuring algal blooms, chemical pollution and bottom bathymetry. For example, NASA has used an aircraft-based LIDAR for calibrating their space-borne optical sensors. CNR programs have worked cooperatively with NASA on extending these data into the ocean volume.

AIRBORNE ELECTROMAGNETIC (AEM) BATHYMETRY

NRL developed an AEM bathymetry system in support of both AMW and MCM. The system measures water depth (0 to 30 m), sediment conductivity, and ice thickness. Several successful proof-of-concept demonstrations have been conducted, and the system is currently being engineered to serve the Naval Oceanographic Office as a quick-response hydrographic survey tool in hot spots like the Persian Gulf.

The AEM bathymetry technique is based on the use of the physical principals of electromagnetic induction in the water and sediments. Using an airborne towed body, an electric field is generated which (when moving over a conducting medium such as the ocean, sediments with water, etc.) provides data on the depth of water and conductivity of the medium.

The AEM system has many potential non-military applications. NOAA and the US Army Corps of Engineers could use the technology to rapidly measure bathymetry in harbors and coastal regions of the U.S. Working with the US Army Corps of Engineers, the system has demonstrated the capability to locate and map buried erosion control structures on the banks of the Mississippi River. Due to the system's ability to measure water conductivity, it can be used to locate and map salt water intrusions into bays and rivers, such as the salt water wedge that traveled up the Mississippi River, threatening the New Orleans drinking water supply. Similarly, the system has the potential to identify weak spots in river levees that have become saturated with water.

AIRBORNE GRAVIMETRY AND PRECISE KINEMATIC GPS

An Airborne Gravity Survey System (AGSS) coupled with a Global Positioning System (GPS) was developed to simplify the logistics and reduce the cost of obtaining detailed gravity data over land, ice and the ocean. This information is important in navigation. Recent S&T efforts through a cooperative effort with NOAA's National Geodetic Survey have developed a precise kinematic GPS as a source of 3-d positioning. When the system is used with a calibrated accurate airborne laser or radar altimeter, it can provide topographic profiles along the flight path. One system is small enough to fit into a Twin Otter, and has been used with the USGS and NSF to acquire gravity and ice thickness in Antarctica. A larger system was flown under sponsorship of the Oceanographer of the Navy in cooperation with the European Space Agency to verify ERS1 satellite altimetry data.

REGIONAL AEROMAGNETICS

The CNR has had, for over twenty years, an international cooperative program of regional aeromagnetic investigations and scientific studies of marine seafloor tectonics. This data are used in ASW and navigation.

The research started in the Arctic in 1972, with an experiment to study the tectonics of the Norwegian-Greenland Sea through the use of Navy operational aircraft. The program has continued to sponsor high quality regional geophysical investigations world-wide since that time. Arctic studies continued through to the mid-70s. This was followed by studies of the Fiji-New Zealand plateau, basin and trench systems in the

late 70's, and the US-Australian cooperative studies of the Australian-Antarctic Discordance. In the 1980s, work continued with cooperative studies of the western South Atlantic with the Brazil, and the western North Atlantic with Canada. In the late 80s a multiyear program of the Weddell Sea was conducted in cooperation with the Argentine Naval Hydrographic Service and Antarctic Institute, the Chilean Mineralogical and Geological Service, and Lamont-Doherty Geological Observatory (LDGO) of Columbia University. Most recently, the program has supported a cooperative effort between the Chilean Mineralogical and Geological Service and LDGO to study the Chile Ridge and its intersection with the Chile Trench, and a continuing cooperative study of the Argintine platform and western South Atlantic with the Argentine Naval Hydrographic Service and Antarctic Institute. The program has also returned to its roots, with the recent agreement between the Navy and the All-Russian Institute for Geology and Mineral Resources of the World Ocean (VNIIOkeangeologia) of St. Petersburg to begin a combined study to adjust and relevel the Arctic aeromagnetics data collected by both countries over the Amerasian Basin of the Arctic Ocean..

SPACE BASED REMOTE SENSING

NRL scientists design, build, test and calibrate about two to three space-based sensors a year, and launch them through the DoD Space Test Program. Sensor development is funded by ONR and NASA, and several have been part of cooperative programs with NASA and European nations. In particular, the Navy S&T community maintains a program of solar investigations important to solar-terrestrial interactions that affect both DoD and civilian operations (as enunciated in the National Plan for Space Environment Service and Supporting Research) such as communications and navigation. Research results are used directly by both the NOAA Solar Environment Laboratory and the Air Force to improve our national ability to provide early warnings of solar disturbances.

In summary, the CNR's S&T capabilities in remote sensing from space, from aircraft, and from in water sensors present excellent opportunities for NASA, NSF, NOAA, USGS, EPA, and DOE to leverage a tremendous amount of on-going expertise and experience in the design, development, testing and calibration of remote sensors.

OCEAN AND MARITIME ATMOSPHERIC MODELING

For a number of years the CNR has continuously funded, as a major S&T effort, research to enable the Navy and the nation to numerically model ocean and atmosphere environmental conditions world-wide. ONR efforts are spearheading the DoD efforts in Global Change. Major field experiments have been conducted in cooperation with NSF, NOAA, NASA, SERDP and DOE in such Global Change Program efforts as TOGA/TOGA COARE, WOCE, JGOFS, and RIDGE.

One specific focus for these oceanographic and atmospheric modeling efforts is the improvement of tropical cyclone forecasts made by the Navy-led Joint Typhoon Warning Center in Guam. The center has responsibility for tropical cyclone forecasts for the mid-west Pacific and Indian Ocean basins, just as NOAA has it for hurricanes in the Atlantic and East Pacific. Navy S&T efforts are seeking to improve our ability to understand and model the complex interactions which control the path and intensity of these tropical cyclones.

Air-sea interaction is a fundamental but complex process, the understanding of which is crucial to predicting the evolution of both the ocean and the atmosphere. The CNR has major S&T programs focussed on improving our understanding of these interactions as they are a critical component of two Navy operational forecast models developed by NRL. These are the Navy's Operational Global (NOGAPS) and Regional (NORAPS) Atmospheric Prediction Systems.

In the area of tropical cyclone forecasting and other atmospheric forecasts, there is a long history of cooperation between NOAA and ONR/NRL. A new area of NOAA/NRL cooperation began this year with an effort to transform global numerical models from reliance on vector super computers to new-generation computers which use Massively Parallel architectures. We expect the first results to be in by the end of next year.

Massively parallel techniques offer potential improvements in capability that we have only begun to explore. Expected breakthroughs in this area will not only dramatically improve forecast speed and accuracy, but will affect the computer industry as well. The technologies and applications currently under development are potentially applicable to many complex numerical problems.

To satisfy the large, complex data management needs of generic ocean and atmospheric models, a software system has been developed by NRL. This system is called the Naval Environmental Operational Nowcasting System (NEONS). It consists of a set of generic database management tools which handle current and anticipated future data sets, unify the data access interface protocols, ingest/export utilities, and permit data browsing. Presently it can handle data received from geostationary and polar orbiting satellites, conventional at-sea field observations, the outputs from numerical models, climatological and geographic data, and terrain and bathymetric data. NEONS is readily portable to a variety of mainframes and workstations. All three sites of NOAA's Global Climate Perspectives program have been provided with NEONS. When new NEONS applications and capabilities are developed by NOAA, they are immediately transferred back to NRL and the Navy.

In ocean modeling, Navy S&T programs have developed a tremendous capability to provide a wide variety of products required to run a global, eddy-resolving, ocean circulation model. Currently, Navy has and is running operational ocean forecast models for particular regions of the world, such as the Gulf Stream, North Atlantic and North Pacific.

A key challenge for all ocean models is data assimilatin from a multitude of sources. The Navy's Data Assimilation and Rapid Transition (DART) project at NRL is presently demonstrating a data-assimilative, high-resolution ocean forecasting capability for the North Pacific. Within a few years it is planned to have an on-line, eddy-resolving data assimilation system for the world ocean. CNR programs are leaders in the use of satellite data as input to models. Recently, NRL used winds forecast by the operational version of the NOGAPS model as input to its Pacific ocean model. The resultant prediction forecast an ENSO (El Nino Southern Oscillation) event, which had previously been unanticipated by other coupled ocean-atmosphere models. News of this prediction carried in some South American newspapers caused considerable reaction.

The Navy's Geosat Follow On (GFO) series of satellite altimeters will provide a wealth of altimetric data for both the Navy and the national S&T ocean modeling community. NRL is responsible for the oceanographic analysis software for GFO and discussions are already underway with NOAA to provide for the civilian distribution of these data.

In summary, the CNR's ocean and atmospheric modeling capability is a national resource, and we welcome cooperative efforts to transition this capability into civilian applications.

ENVIRONMENTAL QUALITY

ONR works with the operational Navy and the DoD SERDP office to develop interagency and civilian cooperative efforts related to Global Change and Environmental Quality. Dr. Oswald will provide the results of the SERDP effort.

To meet Navy needs for environmentally safe ships (ESS) and the marine environmental quality (MEQ) of naval harbors, estuaries and adjoining coastal regions, ONR has initiated two significant, long-term environmental quality S&T programs. Further, the CNR is leading the interagency effort (with DOE and EPA) to look at radionuclide pollution in the Arctic, and NRL is to lead the first cruise to study this problem in Russia's Kara Sea this summer.

The Office of the Undersecretary of Defense (Acquisition) has asked NRL to be responsible for providing a review and analysis of deep ocean dumping of industrial waste. The review is being conducted in cooperation with civilian organizations. An example of CNR-developed technology that led to this request is the environmental cell (EC) for use on a transmission electron microscope (TEM) to study seafloor sediment microstructure. Measurements of sediment geochemical and geotechnical properties of importance to several Navy warfare areas. The EC technology allows researchers to view thicker sediment samples in a hydrated (i.e. wet) state, a more natural condition than the previously used dry technique. In addition, this technique permits introduction of two liquid or four gaseous reactants into the sample under study. The resulting reactions can be viewed (and video-taped) in real time and the images analyzed or enhanced by computerized methods. EC technology makes chemical and mineralogical analysis on a sediment microstructure scale possible for the first time.

This TEM/EC system is presently being used in environmental quality and pollution studies. For example, the TEM/EC can be used to study the mobility and retention potential of pollutants in sediment systems. An understanding of these processes has far-reaching applications to

understanding the entire air-sea-seafloor eco-system. At present, this understanding does not exist. The TEM/EC can also be used to evaluate the structural strength and sediment stability of very soft sediments. Such knowledge is essential for the design and site selection of structures in soft-bottom, shallow water areas.

An exciting use of the TEM/EC capability is in biomedical research. This system offers the capability to observe the living receptors that control the activity of cells, such as the insulin receptor. Presently, the cells must be destroyed before viewing, but EC technology does not require this for accurate measurements. Other areas of similar potential for use of the TEM/EC include the petroleum industry; chemical and related industries; colloidal chemistry; fine particle analysis; biochemical studies of marine organisms; atmospheric particulate studies; pollution in air, water, soils, and other sediments; material sciences; hydrology; agriculture; ceramic technology; etc.

CNR is sponsoring a number of major research efforts focussed on improving our understanding of coastal ocean and atmospheric circulation, and coastal sediment transport. These have significant promise in such areas as improving coastal environmental quality, coastal recreational safety, and understanding the ebb and flow of the sand on beaches. CNR has had cooperative projects with the US Army Corp of Engineers (USACE), NSF and USGS in these projects.

These efforts have all had or offer the prospect for cooperative research efforts with a variety of federal agencies (NOAA, DOE, EPA, USGS, NSF, NASA, USACE) and the civilian community.

SUMMARY

The overall impression I wish to leave with you is that the Navy's S&T community has a significant history and track record in state-of-the-art technology development and is an important and integral component of the U.S. and international oceanographic and marine atmospheric environmental research effort. Although the CNR S&T efforts are undertaken to improve the design, development and utilization of Naval systems, the technology developed often has wide and valuable application to civilian sector problems and programs.

As S&T mission agencies, ONR and NRL are successful only if their research products can be successfully transitioned to the Navy. We are now also focussing on other federal and civilian customers. The relationships and cooperative programs with other federal agencies, academic institutions, and industry that I have described are only the starting point. The CNR is committed to maximizing the development of dual use technologies and other products and their successful transition to civilian uses.

Questions for August 4, 1993 hearing on
Dual Use of Technology and Resources for Civilian and Defense Oceanography

Dr. Hartwig:

1. Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?

2. In terms of ocean models and data, what are the security concerns? Why are certain data not released or released after a waiting period?

3. Among the technologies that you talked about, are there ones which would be applicable for remotely assessing fisheries? Could any of them be used for marine mammals and endangered species other than whales?

4. You mentioned that NRL is responsible for providing a review of deep ocean dumping of industrial wastes. Besides the technology which has been developed, could you tell us how this review is going?

HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES
SUBCOMMITTEE ON OCEANOGRAPHY
GULF OF MEXICO AND THE OUTER CONTINENTAL SHELF
HEARING ON: DUAL USE OF DEFENSE TECHNOLOGY
AUGUST 4, 1993
QUESTIONS FOR THE RECORD TO DR. ERIC O. HARTWIG

Question 1. Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony ?
Answer: Yes, I see potential commercial applications for the technology developed. For example, the acoustic seafloor characterization systems are able to map geotechnical properties of the bottom useful for engineering design in the construction and placement of items such as bridges, pipelines, and piers. Hyperspectral characterization is potentially useful in a wide variety of environmental surveys of ocean, fresh water and land areas for vegetation, suspended material, fisheries, and pollution. Ocean and maritime atmospheric forecast and data base capabilities offer potential applications to commercial ship routing, local weather forecasts (such as Accu Weather) and environmental pollution dispersion prediction (such as oil spill trajectories).

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Question 2. In terms of ocean models and data, what are the security concerns? Why are certain data not released or released after a waiting period?
Answer: Classification of models and data and waiting periods are not set by organizations such as ONR, we follow security guidelines established for classified material. There are some obvious reasons for security concerns. For example we may not want the location of a platform taking data to be known, therefore the data is held for a period then released. This protects the operation and the people involved. In other cases, the release of the data/model would provide a potential adversary the information they need to counter our capability or enable them to rapidly and/or inexpensively develop the same capability, a capability the U.S. may have spent millions or billions to develop. Questions on specific data sets would have to be responded to by the activity having security responsibility for that data.

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Question 3. Among the technologies that you talked about, are there ones which would be applicable for remotely assessing fisheries? Could any of them be used for marire mammals and endangered species other than whales?
Answer: For fisheries the Hyperspectral and Lidar technologies might be useful. In addition, some of the active acoustic technologies may have payoff to fisheries. In that regard we have worked and plan to continue working with two NMFS Pacific labs using acoustic techniques. Ocean and atmospheric modeling can also affect fisheries in optimization of localization for fish stocks that track ocean features such as fronts, or the survival of larval fish stocks as effected by phytoplankton density. With respect to these technologies being useful for other marine mammals and endangered species, the active acoustic technologies probably have the most hope of being useful.

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Question 4. You mentioned that NRL is responsible for providing a review of deep ocean dumping of industrial wastes. Besides the technology which has been developed, could you tell us how this review is going?
Answer: The review is proposed for funding through the SERDP program. NRL has not yet received word that the proposal has been funded. We have made contacts with other agencies, industry and academia and will proceed with the review once the proposal is funded.

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FISHERIES

KENNETH I. DAUGHERTY
DEPUTY DIRECTOR OF THE
DEFENSE MAPPING AGENCY,
TESTIMONY BEFORE THE
SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO,
AND THE OUTER CONTINENTAL SHELF
OF THE
HOUSE COMMITTEE ON MERCHANT MARINE AND FISHERIES
4 AUGUST 1993

(UNCLASSIFIED)

Hearing Before the
House Committee on Merchant Marine and Fisheries
Subcommittee on Oceanography, Gulf of Mexico,
and the Outer Continental Shelf
4 August 1993

List of Witnesses and Other Attendees

Principal:	Dr. Kenneth I. Daugherty Deputy Director Defense Mapping Agency
Support Witness:	Ms. Laura B. Snow Chief, Program/Budget Office Defense Mapping Agency

Biography

Defense Mapping Agency

DR. KENNETH I. DAUGHERTY
DEPUTY DIRECTOR

Dr. Kenneth I. Daugherty is the Deputy Director of the Defense Mapping Agency (DMA), Fairfax, Virginia.

He assumed duties as Deputy Director, the senior civilian position of the Defense Mapping Agency, on 1 April 1993.

Dr. Daugherty was born in 1935 in Jamboree, Kentucky. He earned a bachelor of science degree in mathematics, geography, and geology from Morehead State College, Morehead, Kentucky in 1957; a master's in geodesy from Ohio State University in 1964; and a filosofie licentiate (1972) and doctorate in geodesy/geophysics (1974) from Uppsala University, Uppsala, Sweden.

He began his Federal career with the Air Force Aeronautical Chart and Information Center, St. Louis (now DMA Aerospace Center) in 1957 holding a variety of line and staff positions. He worked on pioneer efforts to establish the role of geodetic and geophysical support for ballistic missile operations and was a member of the USAF Science Advisory Board group on geodesy and geophysics in 1967. From 1967 to 1974, Dr. Daugherty was with the University of Hawaii as associate professor of geodesy and geophysics and assistant/associate director of the Hawaii Institute of Geophysics where he taught and conducted research in physical geodesy, satellite geodesy and marine geodesy and geophysics. From 1971 to 1972, he was a student and visiting scientist at the Geodetic Institute in Uppsala, Sweden.

Since returning to DMA in 1974, Dr. Daugherty's career has been one of continued advancement into positions of significant responsibility and demanding leadership. In 1974 he was chief of the Department of Geodesy, DMA Topographic Center. From 1975 to 1979 he held two key management positions dealing with source material acquisition and multi-year programming at Headquarters DMA and from 1979 to 1986 held the position of technical director at the DMA Hydrographic/Topographic Center. From 1986 to 1987 he served as the deputy director for Research and Engineering at Headquarters DMA.

Dr. Daugherty was the director of DMA Systems Center from 1987 to 1991. In October 1990 his responsibilities at the Systems Center were increased as he assumed the additional role as Headquarters DMA deputy director for Research and Engineering. On 1 July he become the Agency's first Chief Scientist, serving in that position until his appointment as Deputy Director.

Dr. Daugherty was a member of the Advisory Board, Center for Mapping, Ohio State University from 1987 to 1991 and of various other national and international boards, study and working groups. Dr. Daugherty has presented numerous papers at scientific symposia on geodesy, geophysics and mapping science during his professional career. Currently, he is a member of the NAS Review Panel for EOSDIS Plans and Agency Representative to the Environmental Task Force.

Among Dr. Daugherty's awards are the USAF Meritorious Civilian Service Award, 1967; DMA Distinguished Civilian Service Award, 1982; The Ohio State University Heiskanen Award, 1983; DoD Distinguished Civilian Service Award, 1986; and the Meritorious Executive Rank Award, 1987. He is a member of the American Geophysical Union and was Assistant Secretary for the International Association of Geodesy from 1979 to 1991. He was also appointed an Honorary Kentucky Colonel in 1986 and elected a Fellow of IAG in 1991.

He is married to Joyce Salisbury Daugherty and has one daughter, Sharon, a graduate student at the University of North Carolina-Chapel Hill. His hobbies are running, reading, and writing.

(Current as of May 1993)

Mr. Chairman:

I welcome this opportunity to appear before you on behalf of the Defense Mapping Agency (DMA) to discuss the dual use of Defense technology for oceanographic research and navigation. I will present:

- an overview of DMA;
- a status report on DMA's cooperative efforts with the National Oceanic and Atmospheric Administration (NOAA);
- a summary of cooperative development efforts underway between DMA and NOAA which potentially benefit the civil sector; and
- highlights of other DMA products serving the oceanographic research community.

I. DMA Overview.

In 1972, DMA was established to consolidate the various unique mapping organizations in each of the Military Departments. In 1986, the Goldwater-Nichols Defense Reorganization Act (10 USC § 193) designated DMA as a Combat Support Agency. Today the 8,200 people of DMA provide mapping, charting, and geodesy (MC&G) information to all elements of the Department of Defense (DoD). MC&G is defined as the collection, transformation, generation, dissemination, and storing of geodetic, hydrographic, cultural and topographic data. Essentially, DMA provides precise geographic information about the earth. Millions of paper maps and charts and massive amounts of digital data are provided annually to ensure the highest state of operational readiness of our military forces and their sophisticated navigation, weapon, and command and control systems. In addition, as I will explain later, DMA also has statutory responsibilities to support the civil sector, particularly with respect to its nautical products. Within DoD, DMA

receives policy guidance and direction from the Assistant Secretary of Defense for Command, Control, Communication, and Intelligence, ASD(C3I), and operational guidance from the Chairman, Joint Chiefs of Staff (CJCS). All DMA resource requirements are entirely contained in the Tactical Intelligence and Related Activities (TIARA) budget. Congressional oversight is regularly provided through review by the House and Senate Intelligence, Armed Services, and Appropriations Committees. This is our first opportunity to provide testimony on DMA programs to the House Committee on Merchant Marine and Fisheries.

DMA receives its requirements for product lines, MC&G services, and product specifications from the Military Departments based on weapons and systems development and Service Doctrine, and from other DoD agencies for joint systems development. Discrete requirements, that is, individual map and chart coverage of these products and services, are identified by Unified and Specified (U&S) Commands based on their assigned missions and taskings. DMA's production priorities are governed by CJCS Memorandum of Policy Number 31 and are based upon the significance of specific MC&G products and services to assigned U&S missions, with emphasis on those areas of the world of highest concern to U.S. interests. These criteria direct DMA's production toward readiness for regional threats as identified by the U&S commanders, ensuring that the Agency effectively responds to warfighter needs in the changing geopolitical environment.

DMA reviews each area requirement submitted and validates it as a candidate for DMA production resources. Each requirement competes for production resources for either the generation of a new product or the maintenance of an existing one. Since funding and manpower resources are not available to satisfy all known requirements, DMA balances its production program across all missions, emphasizing the

satisfaction of the most critical products for the most likely missions first. Availability of product source materials also influences the final production program.

II. DMA's Cooperative Efforts with NOAA in Support of Defense Requirements.

DMA maintains a worldwide nautical chart portfolio for Defense use. In so doing, we produce nautical charts of waters other than those of the United States or its territories, the excepted waters being the responsibility of NOAA's National Ocean Service (NOS). Annually, DMA contributes over $13 million to the maintenance of NOS's chart data base. We incorporate approximately 1,000 NOS charts into our portfolio, a number which reflects virtually all their standard nautical charts as well as charts produced only for DoD. Last year over 760 thousand copies of NOS charts were brought into our distribution system which resulted in a payment to NOS of an additional $970 thousand.

Nautical charts require frequent correction if they are to support safe navigation. Since DoD uses both DMA and NOS charts, DMA has assumed the responsibility on behalf of both agencies for disseminating corrections for both sets of charts through weekly Notice to Mariners. This need for correction is also a major consideration in our production scheduling, as it requires new editions or corrected reprints of existing charts rather than production of new charts. This maintenance work represents the bulk of DMA's nautical program.

In addition, DMA as part of an international radio warnings service is responsible for preparing coastal and high seas radio navigational warnings, and is the coordinator of two of the 16 Navigational Warning areas which cover the world.

Although our production responds to Defense requirements, DMA's statutory (10 USC § 2791-94 and 44 USC § 1336) responsibility to the civil sector requires that we make available to the mariner in general such products as our nautical charts and Notice to Mariners which would enhance maritime safety. We do this now, very effectively, through the commercial sales agent network managed by NOS. This support to the civil sector, and similar support related to Flight Information Publications, represents approximately 13 percent of our production effort.

The production of nautical charts involves the collection of data from many sources. The majority of our charts are based on information received from the national hydrographic authorities of other nations. To facilitate this, DMA shares with NOS the role of National Representative to the International Hydrographic Organization (IHO), which gives an inherent benefit of the free exchange of hydrographic information with 58 other countries. Further, all Member States of the IHO collect data and produce charts to agreed international standards, which gives some assurance of quality control. In addition, among the 90 bilateral agreements DMA has in place with co-producing nations for a broad range of its products, 55 include arrangements for nautical program cooperation.

When surveys of foreign waters are required, DMA normally relies on the Navy for data collection. If the Navy is unable to respond to such a survey request, the Department of Defense may contract with NOS if the waters are not too distant, as was done for hydrography on the Nicaraguan Rise. When surveys for charting purposes are needed of U.S. waters, this is an NOS responsibility and DMA will always request NOS to program action. If, as has been the case in recent years, civil priorities or a lack of resources have prevented timely

NOS response, DMA takes action to satisfy the requirement. DMA may contract NOS to allow them to put some of their reserve assets back into service, or may task the Navy to carry out the survey, as it did for the one of Vieques · Island.

Defense needs for charts or hydrographic data are not always for surface navigation, the main purpose for which NOS and most other nautical charts are designed. We must support submarine navigation, mine countermeasures, mine warfare, anti-submarine warfare and other activities. When these other military applications drive a survey requirement in U.S. waters, the circumstances, particularly security classification, of each project dictate the preferred data collection means, but usually the initial request will be made to NOS. We are now in discussions with NOS on establishing real-time systems for tidal current forecasting in specific ports to meet Navy home-porting needs, and on detailed surveys required to ensure safe training areas for Navy ships as they prepare for a coastal warfare contingency. We expect both of these efforts to be joint ventures, and all collected data will be shared.

In general, NOS has provided adequate support to DoD's requirements. When DoD requires products which involve NOS survey data collection, major NOS recompilation, or compressed schedules beyond NOS's ability to program and budget, then DMA, if resources permit, establishes a contractor relationship with NOS and reimburses them to satisfy the requirement. We would, of course, prefer that NOS, through some means such as the existing but currently untouchable Harbor Trust Fund, be allowed resources adequate to meet that agency's responsibilities in support of the Department of Defense.

In addition to hydrographic cooperation, DMA participates in joint ventures with NOS's Coast & Geodetic Survey (C&GS) in the geodesy and geophysics (G&G) fields. DMA computes and publishes the official DoD precise orbits, or ephemerides, for the Global Positioning System (GPS) satellites. C&GS has also developed the capability to generate GPS ephemerides for the civil sector. DMA continues to provide C&GS with GPS data and ephemerides so that C&GS can verify their computations. In addition, DMA has supplied gravity data from the DoD Gravity Library and has loaned C&GS a significant number of gravity meters in order to assist in the development of a highly accurate geoid, the theoretical mean sea level as defined by the gravity field of the earth, in the United States. DMA funded the development of the first portable absolute gravity meter, jointly purchased one of these meters, and turned it over to C&GS for operation. Absolute gravity measurements support a number of programs, including global climatology. DMA is assisting C&GS in its program to position airfields in the South Pacific Islands for the Federal Aviation Administration. G&G program managers from DMA and C&GS are constantly communicating about projects of potentially mutual interest.

III. Cooperative Development Efforts which Potentially Benefit the Civil Sector.

DMA has two cooperative development efforts presently underway with NOAA to benefit DoD and civil marine navigation and, potentially, also the scientific community. These initiatives are the Digital Nautical Chart Production Program and the Defense Hydrographic Initiative. A third DMA development effort, the Hydrographic Data Recording System, offers potential for mutually beneficial cooperation with NOAA, the U.S. Coast Guard, and the civilian maritime community.

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A. The Digital Nautical Chart Production Program

The U.S. Navy has identified, and DMA has agreed to satisfy, a requirement for a new digital product to be used for shipboard tactical navigation. Operational requirements for this new product, called the Digital Nautical Chart (DNC), will begin in 1994. The goal of this program is to provide a digital replacement for the paper nautical chart by the year 2000. The DNC contains data that is functionally equivalent to current harbor, approach, coastal, and general nautical paper charts. Estimated total DoD-required coverage, equivalent to approximately 4,000 paper charts, will be issued on Compact Discs. NOS's C&GS has agreed, with partial DMA funding support, to satisfy the Navy requirement for DNC's within their area of responsibility. Equipment and processes for the production of DNC's, where feasible, are being jointly developed by our two agencies. This cooperation, which is very important to us, will also benefit C&GS by accelerating their own production of digital charts for the civil mariner. The DNC may also aid scientific research by serving as a display base of the coastal region in Geographic Information Systems.

B. The Defense Hydrographic Initiative

DoD and civil maritime and scientific communities require hydrographic and bathymetric data of ever-increasing accuracy and coverage. The availability of precise satellite navigation systems, and the integration of these systems with DoD command and control systems, highlight the expanding demand for these data. The diversity of supply sources (e.g. academia, industry, DoD laboratories, U.S. Navy, DMA, NOS, and foreign) requires coordination and oversight. Additionally, emerging technologies for the application of MC&G data require product specifications and implementation. DMA is progressing, with the participation of NOS, in several research and development initiatives that will improve the collection and management of

hydrographic and bathymetric data as well as the accuracy of both DMA and NOS charting programs.

The Defense Hydrographic Initiative (DHI) is a cooperative, interagency effort involving DMA, NOS and the Oceanographer of the Navy. It addresses hydrographic and bathymetric requirements for products and services to ensure concept continuity for research and development as well as production and distribution of hydrographic and bathymetric products.

DHI addresses three basic capabilities: Management tools supporting surveys and operational and production planning as well as monitoring data collection activities status; an archive, accessible by DoD users and, where security and copyright restrictions permit, accessible by civil agencies, for hydrographic and bathymetric source data; and a geo-referenced data base of point, grid and vector hydrographic and geophysical data in support of Geographic Information Systems, which we refer to as the Master Seafloor Digital Data Base. Systems and capabilities being developed as a result of DHI are expected to be operational in the FY 1996 to FY 1997 time frame. Common equipment and processes for these functions are expected to be delivered to DMA in Bethesda, Maryland; the U.S. Naval Oceanographic Office in Bay St. Louis, Mississippi; the C&GS in Silver Spring, Maryland; and NOAA's National Geophysical Data Center in Boulder, Colorado.

C. Hydrographic Data Recording System

The Hydrographic Data Recording System (HDRS), also known as the Digital Sounder, is an initiative that will enhance data collection capabilities for "ships of opportunity" which transit data-sparse areas. DMA is leading the research and development effort to address a "suitcase" design for the HDRS. The concept is to create a highly portable, non-intrusive,

carry-on package, costing approximately $50,000 per unit, consisting of the HDRS suitcase, a standard computer monitor, an accurate Global Positioning System receiver, and a mass storage device, that could automatically record digital hydrographic data continuously from any surface ship equipped with standard depth-finding transducers. An engineering model and documentation supporting acquisition of operational systems are to be completed in September 1994. Routine operational use could commence as early as 1995. The HDRS would be deployed first on Navy surface ships that transit data-poor areas. This concept could be expanded to increase data collection in U.S.-controlled waters by placing suitcases on U.S. Coast Guard, NOAA or other civil vessels.

IV. Other DMA Products Serving the Oceanographic Research Community.

DMA has made other products available to the public whenever circumstances permitted. Two recent digital products of interest to the oceanographic research community have been the World Vector Shoreline (WVS) and the Digital Chart of the World (DCW). The WVS currently presents the world's shorelines, international land boundaries, and country names at a nominal scale of 1:250,000. It is available on nine-track magnetic tape. It is being upgraded to present that same data at variable, reduced resolution scales and also to include maritime boundaries, and will be made available on a CD-ROM. The DCW, developed by DMA jointly with the United Kingdom, Canada and Australia, and supported by NATO Cooperative Defense Funds, is based on the 1:1 million scale aeronautical Operational Navigational Chart series, and includes such topographic information appropriate to that scale as roads, railroads, power lines, cities, and international boundaries. It is now available as a set of four CD-ROMs. Both WVS and DCW have been well received by the scientific community as well as by Defense and other federal agency users. These products

often serve as a backdrop for oceanographic information displayed in a Geographic Information System or spatial environment.

Conclusion:

DMA has a rich tradition of cooperation with the National Oceanic and Atmospheric Administration and other federal agencies. This partnership has resulted in the sharing of mapping, charting, and geodetic data and assets which have directly contributed to defense and civil agency missions and promoted the safety of navigation. DMA sees significant potential for continued cooperative efforts which will result in substantial benefits to the defense community, other federal agencies, civil mariners, and the oceanographic research community.

Shared Technology in the Academic R & D Community

Statement to the Congressional Sub-Committee on Oceanography, the Gulf of Mexico, and the Outer Continental Shelf

4 August 1993

Dr. William J. Schmitz, Jr.
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Academically-oriented research directed toward describing and understanding the physics of the world ocean and the waters along its coastal boundaries has made major progress over the past 50 years in the United States. Prior to World War II other countries, notably England, Japan and Germany, occupied prominent positions in ocean science. Recently many other nations have become competitive with the U.S. in physical oceanography, including the deployment of high tech instruments and platforms used in the measurement of ocean currents, temperatures, and salinities.

In the period inmmediately following World War II, the U.S. Navy, primarily through the Office of Naval Research (ONR), provided most of the financial support for academic physical oceanographic research in the U.S. The National Science Foundation (NSF) began to play a prominent role in this regard in the late 60's, and especially in the 1970's with the onset of the International Decade of Ocean Exploration. NSF is now the leading source of funds for R & D in our field, with the Navy still playing an important role, notably in the development of technology. Although increasingly more mission-oriented, ONR-supported studies continue to contribute greatly to fundamental knowledge in ocean physics. In-house research by the National Oceanic and Atmospheric Administration (NOAA) in the past 30 years has made important contributions, especially to the El Niño–Southern Oscillation (ENSO) problem, and has recently become more diversified and academically oriented. NOAA should play a prominent role in ocean climate in the future.

The oceanic data base is still very sparse, especially relative to what is known about the atmosphere. Numerical models are yet embryonic and more computer power is needed. Although massive expansion of our oceanic R & D is not required, a consistent level of support is necessary and justified by past and present advances in this field of study, especially ocean climate. Significant re-organization and overall

direction of the national effort is not required, there is already plenty of bureaucracy and management. However, more national coordination could be helpful, especially if bureaucracy were reduced. ONR is the best example of efficiency and streamlined procedures; unfortunately through programs like WOCE (World Ocean Circulation Experiment), our community is burdened with too much management being done by oceanographers who are supposed to be doing research.

Generally speaking there is no problem with technology transfer between R & D projects supported by the various agencies. For example, mooring and current meter and neutrally buoyant float technology developed at the Woods Hole Oceanographic Institution under ONR auspices in the 60's and 70's is now routinely used throughout the community. This is also the case for the CTD, an automatically recording, wire-lowered instrument measuring conductivity (salinity), temperature and depth (pressure), as well as the XBT (expendable temperature–depth traces for the upper ocean). These instrument systems are readily available commercially, and widely and routinely used by Naval Laboratories and System Commands and Operational units as well as the academic R & D community. All of these efforts represent at least some example of spin-off and then spin-on as well as dual-use. The biggest problem in the future will probably be adequate market pull.

Technology transfer from the more applied segments of the Navy may not be as easy as it is in the R & D community, although I've heard of several good examples. This area could really open up with the national priority on defense conversion. But this is not my sphere of expertise. Again, market pull (or possibly management inertia) will probably be the limiting factor, as opposed to any technical constraint.

UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

OCT 22 1993

The Honorable Solomon P. Ortiz
Chairman, Subcommittee on Oceanography,
Gulf of Mexico, and the Outer
Continental Shelf
Committee on Merchant Marine and
Fisheries
House of Representatives
Washington, D.C. 20515-6234

Dear Mr. Chairman:

Enclosed are the National Oceanic and Atmospheric Administration's responses to questions received from the Subcommittee as a follow-up to its August 4, 1993, hearing on the dual use of technology and resources for civilian and defense oceanography.

If you or your colleagues have any further questions, please contact James Truesdale at (202) 482-4981.

Sincerely,

D James Baker

D. James Baker

Enclosure

cc: Congressman Gerry E. Studds

THE ADMINISTRATOR

FOLLOW-UP QUESTIONS FOR DR. D. JAMES BAKER
BEFORE THE SUBCOMMITTEE ON OCEANOGRAPHY,
GULF OF MEXICO AND THE OUTER CONTINENTAL SHELF
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES
AUGUST 4, 1993

Question 1: Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?

Answer: Better information often has commercial value. But, it remains to be seen whether data made available from dual-use could stimulate specific commercial uses. That will depend on details we simply do not yet know for most of the systems and the potential markets. One example, however, may give an idea of the possibilities. Several companies already sell ocean-routing forecasts to maritime ship operators. Their objective is to reduce cargo damage and delays by avoiding areas of rough seas. The Over-the-Horizon radar could provide detailed sea surface condition information on a routine basis, which these companies might in turn use to make improved routing recommendations to their customers.

Question 2: In his testimony, Mr. Winokur described some of the advances that have come as a result of the Whales '93 experiment. As the primary federal agency with jurisdiction over whales, have NOAA scientists been directly participating in this study?

Answer: NOAA/NMFS scientists have not participated directly in the Whales '93 experiment. NOAA/NMFS scientists have made site visits to Navy facilities where the Whales '93 experiment is in progress to consult with the Navy's contractor and Navy technical staff to plan for joint NOAA-Navy follow-up experiments to Whales '93.

Questions 3: What are the implications for NOAA's marine mammal management responsibilities?

Answer: NOAA/NMFS believes that the Integrated Undersea Surveillance System (IUSS), i.e., the Sound Surveillance System (SOSUS) and the Surveillance Towed Array Sonar System (SURTASS), offers an unprecedented opportunity for tracking and assessing the status and seasonal distribution of endangered whales, and or developing quantitative assessment capability that has the potential to greatly surpass current survey techniques. IUSS may represent a "next-generation" approach to protected resource assessment that could reduce the annual costs of vessel and aircraft surveys significantly, and that would allow many more regions and populations to be monitored with less effort compared to the capabilities of traditional assessment methods. However, demonstrating assessment feasibility of IUSS will require

cooperative programs between NOAA/NMFS and the Navy to design and implement sighting surveys and analyses to "ground truth" the acoustic signals detected by IUSS and ensure that they are generated by whales. NMFS is proposing simultaneous vessel sighting surveys and SOSUS or SURTASS activities to validate species identification, and to determine frequency of acoustic detection of sighted whales.

Question 4.1: Using the IUSS system can you actually differentiate fishing vessels using driftnets and those using legal methods?

Answer: Information from the IUSS system can be used to locate individual vessels, monitor their movements, and continuously monitor their sound "profiles." A vessel's activities may be inferred from interpretation of its movements and its sound output or "profile" (e.g., transiting, setting or retrieving fishing gear, etc.). Characteristic movements and sound profiles of a suspicious nature can be investigated by enforcement vessels and aircraft to confirm the suspected vessel's location and activities.

Question 4.2: Are there other marine species that the IUSS can be used to detect?

Answer: The IUSS system detects low frequency sounds, and thus detects low frequency sounds of biological origin like those produced by large whales. NOAA/NMFS scientists wish to explore the potential for using IUSS to detect and to identify other species that produce low frequency sounds (e.g., other marine mammals and some fish).

Question 4.3: Can the system be used to detect foreign vessels fishing illegally in U.S. waters?

Answer: In theory, in certain areas, under certain conditions, yes. The system was not designed to "look" for fishing vessels operating illegally inside U.S. waters. It was designed and developed to "look" for subsurface targets that normally operate outside U.S. waters. Whether or not the IUSS system can detect any fishing vessel activity in the U.S. EEZ has yet to be determined. Areas of interest would need to be developed and a wide range of tests and experiments conducted in those areas with cooperative vessels to determine whether the system could:

1. Receive any sounds at all from the concerned area;

2. Distinguish sounds of a fishing vessel from those of other vessels;

3. Distinguish sounds of a domestic vessel from those of a foreign vessel; and

4. Provide locations accurate enough to warrant deploying other resources (planes or ships).

If the tests were successful, it may be possible to use the IUSS system in conjunction with other classified and unclassified targeting systems to provide information on which to make decisions for deploying resources to verify and document any illegal activity.

Question 5.1: Among the technologies that you talked about, are there ones which would be applicable for remotely assessing fisheries?

Answer: NOAA/NMFS scientists are proposing to explore the potential for using IUSS in a passive "listening" mode and in combination with active hydroacoustic methods (e.g., sonar) to assess fish stocks. See also the response to Question 4.2.

Question 5.2: Could any of them be used for marine mammals and endangered species other than whales?

Answer: Yes, in addition to IUSS, NOAA/NMFS believes that some satellite programs could be used to assess populations of seals and sea lions that haul-out along coastal regions. See also the response to Question 4.2.

Question 6: During an earlier hearing on the National Undersea Research Program (NURP), there was discussion of the use of Naval submersibles by the program. The general consensus was that the Naval subs represent a valuable asset, but the way they are operated and the constraints on availability make the systems difficult to count on. What can be done to make these systems more 'scientist friendly' and more reliable?

Answer: Prior to December 1991 the civilian use of Navy deep submersibles generally was arranged by individual investigators. Access and scheduling was a significant challenge.

In 1992 the DSV SEA CLIFF Hawaiian science cruise was the pilot program under a formal Memorandum of Agreement (MOA) between NOAA-NURP and the Navy, through which the Navy's deep submergence research vehicles will be made available to the U.S. civilian science community. The program was from mid-September to

mid-November and included ten groups of scientists who used the vehicles to study the geology, geochemistry, biochemistry, and biology off the Hawaiian Islands. This was the deepest and most prolonged dive series undertaken by the Sea Cliff entirely for science. A total of 13 Sea Cliff dives and three ATV dives (to depths primarily between 12,000 and 18,500 feet), along with 2400 square nautical miles of Sea Beam bathymetric surveys were accomplished during this series.

Unfortunately, the Sea Cliff previously had not been exposed to such a rigorous deep diving schedule and there were several mechanical and electrical problems. The Navy has a program underway to solve the reliability issue.

One aspect of a solution will be to expand current efforts under the existing MOA with the Navy. That agreement allows NURP to fund a regular schedule of civilian scientific cruises up to 60 days per year. It includes provisions to train Navy crews and provide work-up periods prior to any extended deep-diving programs. In addition, cameras and other sensors utilized by scientists could be upgraded on the submersibles on a regular basis.

Questions from Chairman Studds

Question 1: What are the factors limiting the modernization of NOAA's navigation-related programs? Is NOAA's effort limited by technology, financial resources, or both?

Answer: NOAA's efforts to modernize its navigation-related programs are limited by financial resources, not by technology.

In fact, recent technological advances should allow NOAA to greatly improve its ability to provide the oceanographic information needed for safe navigation, assuming funds are available for implementation, operation, and maintenance of the new technologies. Modern state-of-the-art measurement technology and modern data and information delivery technology now make it possible to provide the accurate and timely information that the marine community needs.

Nautical surveys need to be updated. Fully half of U.S. waters less than 30 meters deep (including 25 percent of our harbors and harbor approaches) were last surveyed prior to World War II when only a small fraction of the bottom could be sounded. Uncharted obstructions such as those encountered by the QUEEN ELIZABETH 2 continue to be a hazard to safe transportation. Technology now can provide full bottom coverage with much greater positional

accuracy. However, NOAA has not had the resources to equip its ships with these shallow-water multibeam systems and high-resolution side-scan systems. Further, the ship time that has been available to obtain new survey data has declined by 60 percent over the past 15 years.

Traditional cartographic techniques are outmoded and incapable of delivering the information needed for modern electronic navigation systems. Automated digital systems are necessary to handle data efficiently. NOAA has developed the Automated Nautical Charting System II (ANCS II). However, current resources are insufficient to build the database to make the system operational. Until ANCS II is operational, NOAA must rely on manual techniques to produce paper charts. Electronic chart systems may soon be mandated for use. These systems can help to avoid accidents such as the EXXON VALDEZ disaster. NOAA cannot provide the electronic chart data needed to operate these systems without a fully operational automated system.

Marine forecasting services must be modernized to provide real-time tide and current information. The Next Generation Water Level Measurement System (NGWLMS) includes the use of acoustic measurement techniques, dissemination of data via GOES satellite, and the ability to handle up to 11 ancillary sensors such as wind, pressure, and temperature sensors. One hundred ninety of these systems have been purchased to complete the National Water Level Observation Network (NWLON), however, NOAA is able to install only 100 because of resource limitations. NOAA has withdrawn its tidal current predictions for two major ports, New York and San Francisco, because they are no longer accurate. The only real-time current measurement system in the nation is installed in Tampa Bay. This system includes not only real-time water level and meteorological data, but also remote sensing of currents over the entire water column using modern acoustic doppler techniques. However, NOAA cannot meet the demand for similar systems in other ports or support the maintenance of Tampa's system.

Question 2: Please provide a table summarizing the funding history of NOAA's navigation-related programs over at least the past five years.

Answer: The following are the appropriated amounts for the mapping and charting line item in NOAA for the past five years:

1993	$31,265,000
1992	32,507,000
1991	31,871,000
1990	29,541,000
1989	27,543,000

Question 3: Without regard to financial constraints, what immediate program actions are required to ensure navigation safety? What other program activities are required in the longer term for NOAA to fulfill its navigation-related responsibilities?

Answer: There are several program areas that need to be worked on simultaneously. These are discussed below.

Nautical Surveys

Areas of critical need should be surveyed as quickly as possible. Equip hydrographic survey ships, launches, and shore-based field parties with current state-of-the-art technology including differential Global Positioning Systems, high-speed high-resolution side-scan sonar and shallow water multibeam echosounders and ensure that well-trained personnel are available to carry out these surveys. Bring airborne laser hydrographic technology into use operationally in suitable areas. Expand photogrammetric shoreline mapping and bring airborne multispectral scanning technology into operational use. Augment NOAA personnel and equipment with contract surveys. Evaluate the effectiveness, productivity, quality, and cost of contract surveys to determine if they are an efficient long-term alternative to additional NOAA ships, launches, and field parties.

Digital Nautical Information

Complete the loading of the new digital nautical charting production system. Bring the system into operational use to produce both traditional paper charts and electronic chart products. Equip the existing hydrographic data processing centers with the necessary hardware and software to process the data collected using the new technologies. Ensure that personnel are capable of effectively utilizing this equipment.

Marine Forecasting

Develop a national Physical Oceanography Real-Time System (PORTS) for the provision of real-time and forecast currents, water levels, and local meteorological parameters (especially wind) to the maritime community. This includes installation of PORTS systems in major harbors and estuaries, and development of a modern real-time-based forecasting capability. In the interim, update the NOAA Tidal Current Tables (which are badly out of date for most of the nation's waterways) by analysis of new data acquired by NOS from circulation surveys and of data sought out from other oceanographic institutions.

Complete the modernization of the NWLON including completion of the Data Processing and Analysis System (DPAS) which was designed to handle the NGWLMS data retrieved in real time via satellite, complete the installation of NGWLMS field units at the approximately 89 remaining stations in the NWLON, and install meteorological and water temperature sensors at all coastal and entrance stations where such data are needed either for navigational safety, or as input to forecasting algorithms.

In the longer term, NOAA needs to (1) provide for the replacement and modernization of its fleet and (2) maintain an effort to evaluate and develop new technologies for data acquisition and management, as well as provision of products and services. The navigation database needs to be structured to provide fundamental data layers for coastal zone geographic information systems to meet the needs of a broad, diverse environmental community and to provide the interconnections to improve products and services for navigation. NOAA's efforts must continue to be coordinated with related efforts of other federal agencies and be well matched to the evolving navigation needs of the maritime community.

OFFICE OF THE DIRECTOR OF
DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, DC 20301-3030

16 SEP 1993

Office of the Executive
Director, SERDP

Honorable Solomon P. Ortiz
Chairman
Subcommittee Oceanography, Gulf of Mexico,
and the Outer Continental Shelf
House of Representatives
Washington, DC 20515-6230

Dear Congressman Ortiz:

Thank you for your letter on August 11, 1993, requesting responses to five additional questions based upon my testimony on August 4, 1993, regarding the Strategic Environmental Research and Development Program (SERDP). Responses to your questions are attached.

If I can be of further service to you, please do not hesitate to contact me.

Sincerely,

R B Oswald

Robert B. Oswald
Executive Director,
Strategic Environmental Research
and Development Program

Attachment

RESPONSES TO ADDITIONAL QUESTIONS FROM HEARING ON DUAL USE OF TECHNOLOGY AND RESOURCES FOR CIVILIAN AND DEFENSE OCEANOGRAPHY AUGUST 4, 1993

1. QUESTION: **Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?**

ANSWER: The Navy's "Enforcement/Stock Assessment and Marine Mammal Monitoring" project will have definite commercial uses and impact. The Integrated Undersea Surveillance System, coupled with existing methods, will result in a more thorough, accurate, and efficient assessment of fishing stocks which directly correlate with the "health" of ocean areas. It will also provide enhanced support to the Coast Guard in its monitoring activities of legitimate fishing vessels while enforcing driftnet violations.

2. QUESTION: **In terms of ocean models and data, what are the security concerns? Why are certain data released or not released after a certain waiting period?**

ANSWER: As indicated in my testimony, an Environmental Task Force (ETF) is determining the potential utility and applicability of classified data for environmental research. The Department of Defense, Department of Energy, and the Intelligence Community will work together to determine which data sets might be declassified and released to the environmental community. It will be necessary to query the Intelligence Community with specific questions concerning progress and interim findings.

3. QUESTION: **Could you briefly explain the process by which your program prioritizes and selects projects to be funded? What ocean related projects has the program funded?**

ANSWER: The SERDP is divided into six separate environmental technology thrust areas. These areas directly parallel the DoD stated thrusts created to respond to priority defense needs. These needs are identified, aggregated, and prioritized by the DoD "user" community. SERDP management solicits proposals in these areas and, with the support of Technology Thrust Area Working Groups, selects projects based on their technical merit, executability, and response to the priority needs.

The following are the titles of SERDP ocean related projects that have been or are anticipated to be funded this year:

- Acoustic Monitoring of Global Ocean Climate
- Ship Paint Reformulation
- Analysis of Submarine Acquired Ice Draft Data
- Numerical Sensitivity studies for the Design of an Ocean Observing System
- Instrumentation Development-Drifting Buoys
- Marine Mammals Studies
- Oil Spill Transport Prediction System
- Shipboard Secondary and Tertiary Bilge Waste Treatment System
- Shipboard Non-Oily Wastewater Treatment System
- Technical and Economic Assessment of Storage of Industrial Waste on Abyssal Plains
- Fishing Enforcement/Stock Assessment and Marine Mammal Monitoring
- Environmental Task Force
- Non-Hazardous, Low VOC Corrosion Paints and Coatings
- Innovative Very Low VOC Antifouling Paints and Processes
- Heavy Metal Discharge from Ship Ballast

4. QUESTION: **What is the relationship of your program with the Advanced Research Projects Agency?**

ANSWER: ARPA has been a full participant in the SERDP in its program development process and conducts research in support of SERDP objectives. ARPA currently receives SERDP funding to execute the "Acoustic Monitoring of Global Ocean Climate" project. ARPA also sits on the SERDP Executive Working Group as well as the SERDP Technology Review Groups.

5. QUESTION: **I understand that under a provision of the FY 1994 Defense Authorization bill (H.R. 2401) your program would be required to conduct assessment of deep ocean isolation of contaminated coastal zone sediments. What research has the Department previously carried out concerning this technology and what form of assessment would be carried out in response to this directive?**

ANSWER: The provision directs the Department, under SERDP, to study "storing" industrial waste on the abyssal plains of the ocean floor. In January 1993, the Director, Defense Research and Engineering received a letter from Senator Inouye clarifying the Committee's intent in requesting the study. He states; "Knowing of existing laws which directly bear on the issue of storing waste in the ocean, the Committee sought only a paper study of the abyssal plains concept. The Committee did not approve, and does not support, any activities beyond this paper study effort."

The project entitled, "Technical and Economic Assessment of Storage of Industrial Waste on Abyssal Plains", submitted under the FY93 SERDP Investment Strategy will conduct this paper study. We know of no previous research that has been specifically conducted to study this concept.

DEFENSE MAPPING AGENCY
8613 LEE HIGHWAY
FAIRFAX VIRGINIA 22031-2137

CMRP

0 9 SEP 1993

Honorable Solomon P. Ortiz
Chairman, Subcommittee on Oceanography,
Gulf of Mexico, and the Outer
Continental Shelf
Committee on Merchant Marine and Fisheries
House of Representatives
Washington, DC 20515-6230

Dear Mr. Chairman:

As requested in your letter of August 11, 1993, enclosed are responses to your followup questions from the hearing on the dual use of Defense technology for oceanographic research and navigation.

I appreciated the opportunity to testify on behalf of the Defense Mapping Agency. Please advise me if you require further information or assistance.

Sincerely,

KENNETH I. DAUGHERTY
Deputy Director

Enclosure
As stated

Defense Mapping Agency (DMA)
Questions and Answers for the Record
4 August 1993 Hearing on Dual Use of Technology and Resources for Civilian and Defense Oceanography

1. Beyond research applications, are there commercial uses for the different data sets and technologies that you discussed in your testimony?

Yes, there are multiple commercial uses. The sounding data we collect is used in DMA's production of nautical charts covering the world beyond U.S. waters. We make these charts available to the civil mariner under Title 10, U.S. Code. Many of these paper charts are digitized by commercial producers of electronic charts for the recreation boater as well as the merchant marine. DMA also makes unclassified bathymetric data available on request to industry for planning cable-laying or other commercial operations.

Similarly, DMA's technical manual and other products relating to the earth's gravity field and the ellipsoid for, and to datum transformation to and from, the World Geodetic System 1984 (WGS-84), are widely used. The WGS-84 is the reference for the Global Positioning System. DMA's world magnetic model, which we generate every 5 years jointly with the United Kingdom, is also used by the private sector and by virtually all foreign hydrographic authorities in producing nautical charts.

We believe that the digital products DMA makes available to the civil community, such as our World Vector Shoreline and the Digital Chart of the World, are used operationally by industry as well as in research. It is difficult for us to know how the products are being used, for they are in the public domain and are often repackaged, or enhanced for special applications, and sold by private enterprise. We know that there is significant commercial interest in bathymetry data, based upon a 1992 study by the Marine Board of the National Research Council (National Academy of Sciences) which ranked bathymetry data as the highest priority data need of offshore industries.

2. In terms of ocean models and data, what are the security concerns? Why are certain data not released or released after a waiting period?

The ocean models and data which are subject to security classification are those which can result in products of significant military value being generated by a potential enemy, or give that enemy a sense of where he might intercept, or hide from, our forces.

In the case of classified bathymetry, the restriction is placed on the data by the collector, the U.S. Navy, not by DMA. Some data can be thinned, or its accuracy slightly degraded, and be declassified in that altered form. Other data, such as some of

Enclosure

our ocean gravity holdings, have been declassified when the benefits to the civil sector far outweigh the potential threat to the U.S. in use by an enemy.

3. We've heard a lot of concerns recently about the quality of NOAA's charts and the fact that much data was gathered long ago using obsolete technology. Are the maps produced by NOAA of sufficient quality for defense use?

NOAA charts are sufficient for the purpose of safe sea navigation by Navy ships which follow normal lines of transit along the U.S. coasts and for the ingress and egress to U.S. ports. In other cases, such as the where the Q.E.II grounded, charts are not adequate for our deeper draft ships, and modern surveys are absolutely required. Perhaps more urgent, however, are the requirements stemming from the Navy's new focus on littoral warfare. It demands much denser, and a greater variety of, data than is now on NOAA charts or available in their data archives in those areas where training is to take place. Further, the Navy's distributed home porting of major ships requires tidal current forecasts much improved over those now available from NOAA in selected ports.

4. You said that DMA will always ask NOAA first to chart waters under its jurisdiction. Is NOAA usually able to respond? What is the reason usually given when they cannot do a job?

DMA has requested NOAA to provide surveys or current studies several times in recent years. The response has generally been that their resources do not allow them to respond, and that reimbursement would be required. I can cite three recent examples:

a. In 1990, DMA forwarded a requirement to NOAA for better charts off Vieques Island, Puerto Rico, to support Navy amphibious training. NOAA's response was that the project had insufficient priority for NOAA to shift its survey assets since no commercial requirements existed for the area of interest. Navy conducted the survey off Vieques, and DMA produced the training chart.

b. In 1991, DMA forwarded requirements to NOAA for larger scale chart coverage of the Aleutians, highlighting the data deficiencies of the area. NOAA responded that it hoped to bring two ships out of its inactive fleet to conduct the hydrographic surveys. However, NOAA did not allocate funding. Currently, no surveys are planned to support safe use of the Aleutians by naval forces.

c. In 1993, DMA identified to NOAA the need for detailed bathymetry to support new charting needs for the conduct of safe, shallow water training for tactical nuclear submarines within the U.S. East Coast Exclusive Economic Zone. NOAA advised DMA that all of its hydrographic and bathymetric resources had been allocated for Fiscal Year 1993. Further, NOAA advised that it had

made policy decisions to shift survey resources from offshore bathymetric mapping to inshore areas heavily used by commercial navigation. NOAA recommended formation of a joint NOAA-DMA working group to study the feasibility of using a recently transferred Navy T-AGOS ship--a project requiring joint NOAA-DMA funding and participation. DMA continues to meet with NOAA on this matter. However, it appears that Navy will have to do the surveys if the charts are to be available within the next few years.

Woods Hole Oceanographic Institution
Woods Hole, MA 02543
Phone: (508) 548-1400
Telex: 951679

30 August 1993

The Hon. Solomon P. Ortiz
Chairman, Subcommittee on
Oceanography, Gulf of Mexico,
and the Outer Continental Shelf
U.S. House of Representatives
Room 1334, Longworth House Office Building
Washington, D.C. 20515-6230

Dear Mr. Ortiz:

Thank you very much for your letter of 11 August 1993 (Xerox attached). I much enjoyed talking to your subcommittee.

With regard to the further questions that I have been asked (Xerox attached): I have had in the past minimal problems interacting with federal agencies in general, and DoD in particular, and this will probably be the case for many academics in the physical sciences. But there can be problems with particular agencies or particular programs. It is also true that the overall level of bureaucracy associated with research has gotten higher and higher during my career, now spanning over 30 years. Surprisingly, the National Science Foundation has been at the forefront of supporting large programs like WOCE that have placed a heavy management burden on scientists who are supposed to be focusing on research. This has occurred at the expense of projects with one or a few principal investigators, and is a trend most academics would like to see reversed. Indeed, small projects were at the core of the original NSF mission. Projects involving large management teams can be carried out by the mission agencies.

Sincerely,

William J. Schmitz, Jr.
Senior Scientist
Clark Professor

WJS/bpg
Encl.

U.S. House of Representatives
Committee on
Merchant Marine and Fisheries
Room 1334, Longworth House Office Building
Washington, DC 20515–6230

August 11, 1993

Dr. William Schmitz
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Dear Mr. Schmitz:

On behalf of the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf, I would like to thank you for testifying at the August 4, 1993, hearing on the dual use of technology and resources for civilian and defense oceanography. Your insight on this matter was greatly appreciated.

As I stated at the hearing, further questions would be submitted to you for written response to be included into the record. Enclosed is a list of questions that the Subcommittee Members and I have requested a response to by September 13, 1993. During the coming months, the Subcommittee will be conducting extensive discussions on the issue of dual use oceanography resources and technology. A timely response is needed for your observations to be considered as part of this process.

Again, thank you for your participation. If you have any questions, please feel free to contact Mr. John Aguirre, at (202) 226-2460.

With kindest regards,

Sincerely,

Solomon P. Ortiz

Solomon P. Ortiz
Chairman
Subcommittee on Oceanography,
Gulf of Mexico, and the
Outer Continental Shelf

Enclosure

Questions for August 4, 1993 hearing on Dual Use of Technology and Resources for Civilian and Defense Oceanography

Dr. Schmitz:

1. We've heard a lot about the interactions between defense and civilian agencies and the prospects for Federal agency science.

--What are the implications for academic researchers such as yourself?
--How easy is it for academics to become involved?

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